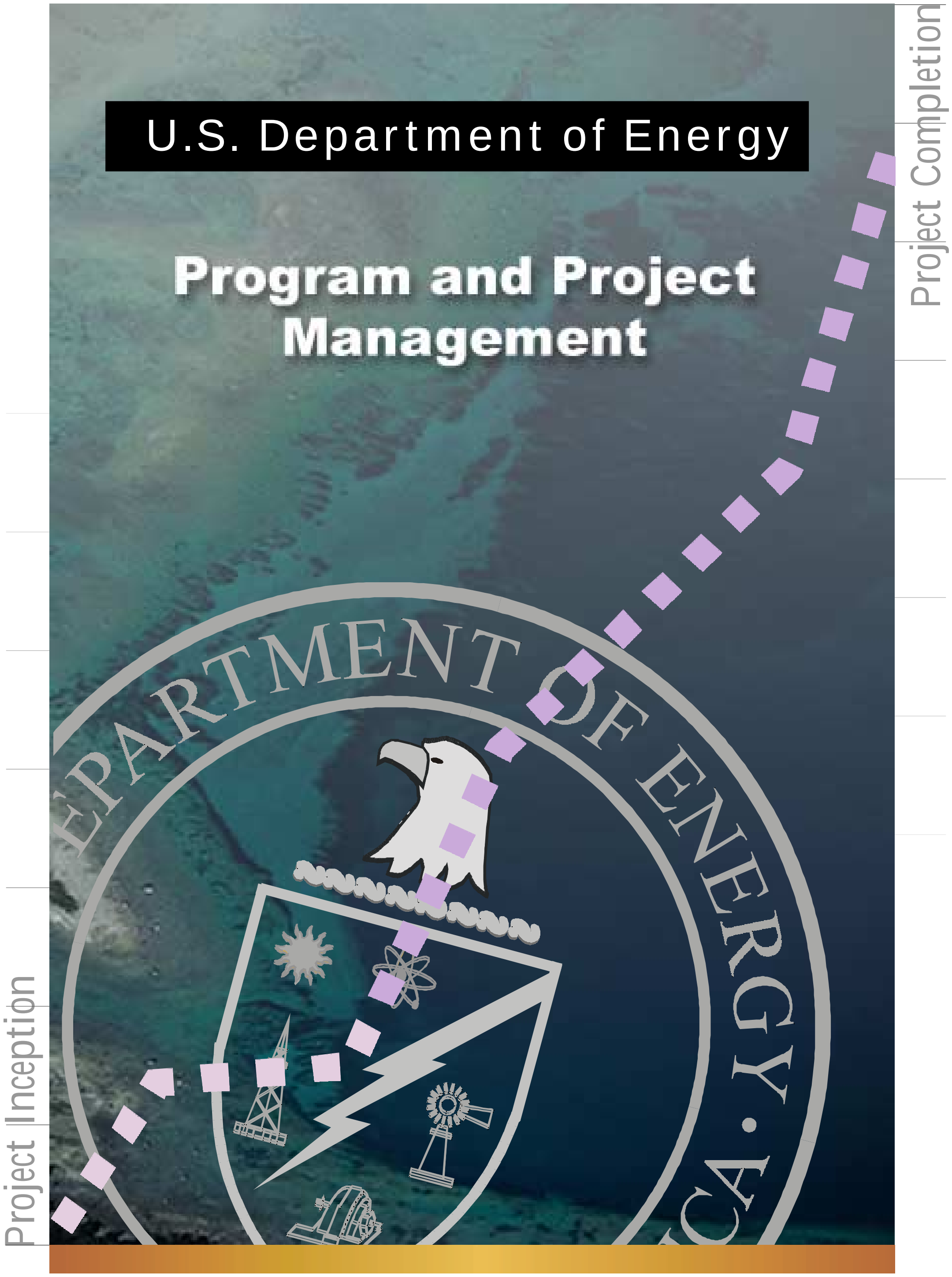
U.S. Department of Energy

Program and Project Management



October 2000

Draft

October 2000
DRAFT

U.S. Department of Energy

Program and Project Management

Approved by: ______________________________
T. J. Glauthier, Deputy Secretary

This page is intentionally blank.

PREFACE

These volumes are provided to program and project personnel for review and use prior to the directives review process. Department personnel are encouraged to contact the Office of Engineering and Construction Management to discuss and comment on sections as the issues warrant. Official comments and responses will be accomplished through the Department's directives management process over the next year.

The development of these processes and practices has been undertaken to provide a common foundation for program and project management across the DOE complex. The primary objective is to assure the application of sound management principles that provide a disciplined, systematic, and coordinated approach to program and project planning, execution, and closure. The goals are to facilitate and support the acquisition of capital assets that meet mission needs and aid in achieving and sustaining excellence in program and project management.

These two volumes will support the Department's mission, enhance management of public funds, and improve our credibility in acquisitions of capital assets, when properly applied and tailored by experienced and qualified program and project managers. Their use will assist in delivering projects on schedule, within budget, and capable of meeting mission performance, safety, and quality standards.

The Department's projects by their nature are diverse and range from conventional construction to complex research and development systems. These processes and practices are broad enough to encompass the large variety of missions and projects undertaken in DOE, while allowing for tailoring to the specifics of individual projects.

Sample forms, matrices, schedules, and plan examples are included that can be used directly or customized. When possible, actual examples of successful strategies or forms are included. The program and project management volume is keyed to acquisition processes and phases, and provides proven project principles and considerations from pre-concept through closure. The practices, which may be applicable to more than one phase, is organized topically and focuses directly on activities or elements of program and project management. The practices are intended to provide substantial level of detail and examples.

This is a work in progress that will continue to evolve. Additional information that is specific to systems, construction, and other types of efforts will be provided in future versions.

This page is intentionally blank.

PROGRAM AND PROJECT MANAGEMENT
TABLE OF CONTENTS

Program and Project Management
List of Figures

This page is intentionally blank.

1 PURPOSE AND OVERVIEW

The Department of Energy (DOE) Order 413.X, Program and Project Management for the Acquisition of Capital Assets, has been recently prepared and distributed for implementation. This Order is mandatory for all DOE projects, including the National Nuclear Security Administration (NNSA), regardless of funding type or phase of execution

The objective of DOE Order 413.X is to provide the DOE project management direction for the acquisition of capital assets that are delivered on schedule, within budget, and fully capable of meeting mission performance and environmental, safety, and health standards.

The Contractor Requirements Document (CRD), an Attachment to the Order, sets forth the requirements of the Order that must be applied to management and operating/management and integration (M&O/M&I) contractors and other prime contractors responsible for project execution at DOE facilities. Contractor compliance with the CRD will be required to the extent set forth in a contract.

This manual describes the initiation and implementation of a program/project from preconceptual through turnover for operation or surveillance. Safety, quality standards, and requirements are also presented. The decision-making and budgeting processes are described, as well as the roles and responsibilities for management and oversight.

This manual contains both requirements and guidance and, in some areas, should be tailored to the size, risk, and complexity of the work to be performed. Tailoring can be applied to all projects for oversight, acquisition planning, performance reviews, reporting, change control, and Critical Decisions (CDs). Tailoring does not exclude application of the requirements, but simply assures application is commensurate with need. Where differences exist between conventional and environmental management projects, parallel activities are described.

1.1 PROJECT GUIDING PRINCIPLES

As a result of project management experience, a number of "guiding principles" have emerged over time. These principles are basic overarching guidance that have been proven applicable to projects and project management activities. Even though the following principles do not appear verbatim in either the manual or the Practices, the philosophy expressed in the principles is reflected throughout both documents.

Leadership

Project management must propagate effective leadership to energize project teams to identify, support, and achieve project objectives.

Roles and responsibilities must be clearly defined with authority and accountability consistent with assigned responsibilities.

Leadership expects and nurtures teaming at all organizational levels.

Leadership engages and uses systematic reviews to ensure mission, safety, and quality criteria are met.

Safety

Project management must demonstrate an unequivocal commitment to safety and environmental excellence.

Quality

Project management must commit to continuous improvement and must consider quality integral to delivering projects.

Human Resources

Project management must emphasize the importance of the continual development of individual and team skills. Suitably qualified and experienced personnel must be assigned to Integrated Project Teams. To the extent possible, the continuity of key project members must be maintained throughout the project.

User/Owner

User/owner organizations must be involved early and continuously in project evolution and decisions.

Stakeholders

Project management must plan and conduct stakeholder activities, including communications on a proactive two-way basis with utmost authenticity.

Processes

Formal tailored processes must be implemented throughout all project phases.

Project Execution Plans (PEP) are the cornerstone of all project planning.

Performance baselines must be rigorous and definitive; risk assessed with sufficient contingency to provide a high confidence of success. Performance baselines are monitored, evaluated, and reported against.

Change control must be rigorous and timely.

Acquisition Planning and Project Execution Planning are the cornerstones of project planning. These are not one-time events, but are meant to guide the project manager in the implementation and execution of project delivery.

Performance baselines must be established, monitored, evaluated, “managed to,” and reported against. Change control must be rigorous and timely, with a strong preference to solutions within the overall scope/performance, schedule and cost baseline.

1.2 PROGRAMMING

The DOE programs are major ongoing activities having defined goals, objectives, requirements, and funding levels , and may include one or more projects. Projects are significant activities identified by a program and characterized as having defined goals, objectives, requirements, life-cycle costs, a beginning and an end.

Programs (and projects) vary significantly in their complexity, cost and importance. Projects are formulated to define an affordable concept and are planned to meet mission objectives that are defined in the DOE strategic plan. In accordance with systems engineering principles, programs explore a full range of implementation options including the development of new technologies. Programs perform life cycle cost and performance analyses on project concepts expected to have a high degree of technical and operational feasibility. Risk management principles are used in cost formulations, and top-level requirements are generated that provide for subsequent assessment of subtier mission operational and project activities. The formulation process is interactive rather than a discrete set of linear steps. Various alternative solutions are considered and the solutions are optimized to determine the implementation approach.

Programs are responsible for establishing ranking criteria for their projects to determine priority and subsequent implementation (or rejection). Based on the outcome of this process, activities enter the budget in an optimum manner. Each program will establish priority guidelines as well as overarching guidelines that will be applied to the selection and implementation of projects. Mission safety, and protection of the public, worker and environment will receive the highest consideration. Stakeholder concerns will also be considered in this process. Decisions will be documented and include review and comment steps prior to finalization.

1.3 PROGRAM/PROJECT ACQUISITION MANAGEMENT

Projects mature through a planned sequence of activities that begins with a concept or identified need, then through a process geared to ultimately produce a desired product. Portions of the project's sequence are timed to produce results that are consistent with the budgetary requirements described in Section 4.

Although each project follows a similar pattern as it moves from one project phase to the next, care needs to be taken to initiate controls and oversight commensurate with the complexity and cost of the proposed work. Management controls are necessary at every level, but should be tailored to meet requirements, not just to assure compliance.

1.3.1 Mission Need/Acquisition Strategy and Strategizing Implementation

Acquisition planning and strategizing for a program or project means obtaining a project or product that is defined as being consistent with the department's or a program's strategic goals, plans, and objectives. This is documented in an Acquisition Plan that evolves into an element of the PEP, a product of the project planning phase and a prerequisite to requesting CD-1. The strategy is to define, in light of the available knowledge of the activity (mission need, conceptual design, etc.), how a project or product may be best and most cost-effectively obtained by the Government. Traditionally, DOE has placed the burden of procuring new products on the M&O/M&I contractors. However, where appropriate, more effective means of acquisition are now being used such as competitive bids, and privatized, performance-based, and incentivized contracts. The approach selected is defined in the Acquisition Plan. The planning and preparation for an Acquisition Plan begins when a Department need is identified, well in advance of when a contract award is planned.

The acquisition strategy and the resultant Acquisition Plan establish the program/project's path forward for selecting the principle participants and their relationships. Since these determinations are necessary early in the life-cycle activity, the development, completion, and approval of the plan should be given the highest priority.

Acquisition Plan

An acquisition strategy serving the Government's best interests shall be developed and documented in the Acquisition Plan. The plan should focus on selecting a prime contractor who is capable of proficiently accomplishing the desired result. This contractor will award lower-tier subcontracts and manage those subcontracts to assure accomplishing system, project or program goals.

The plan shall specify the dates (milestones) when decisions should be made to facilitate attainment of the acquisition objectives. The plan shall address all the technical, business, management, and other significant considerations that will control the acquisition process. Depending on the nature, circumstances, and stage of the acquisition, the specific content of plans can vary, However, the more important contents include:

- Background and objectives, including program or projects mission need and program relationship
- Scope of work outline
- Development and testing requirements and planned tradeoffs
- Cost, budget, funding and life cycle considerations
- Schedules, including milestones
- Proposed approach to procurement including sources; competition; make or buy; selection process; prime contractor; contracting methods; options and milestones. A performance-based contractor incentive process and a statement whether the Government or a prime contractor will conduct the competition.
- Safety requirements

A complete outline of elements that should be included in an Acquisition Plan is included in Practice 2, Acquisition Strategy and Plan.

Integrated Project Team

An Integrated Project Team (IPT) shall be responsible for developing the Acquisition Plan. The IPT, led by the Federal project manager, is approved by an appropriate SAE or AE. The IPT should consist of a Program Manager, a Federal Project Manager (once assigned), and a Contracting Officer who is provided or approved by a Director of Procurement. Because of the IPTs diverse responsibilities, the team also includes personnel having background and experience in contracting, fiscal, legal, and appropriate technical field. **At specified times or whenever significant changes occur, the IPT shall review and revise the plan, as appropriate.**

As early as possible, the IPT should establish quality, quantity, and delivery requirements; the contracting method to be employed; and whether procurement specialists need to be included in the team.

1.4 PROJECT OVERVIEW

Projects are specific undertakings that involve diverse scopes of work, ranging from designing and building a new high energy testing facility to developing a new computer system. No matter how dissimilar, all projects can be characterized by being divided into specific phases, which have a beginning and an end. The sum of these phases is called the project lifecycle.

The task of defining a project by lifecycle phases is a necessary first step toward successful project management. Through this approach, the application and integration of the proven techniques of project management drives the improved performance and manageability of work accomplishment.

For clarity, the most commonly understood project (design and construct) is used as the generic bases for this manual. For other lifecycles and phases, substantial coverage is provided by the Project Management Institute (PMI) PMBOK®, as well as a vast array of literature on project management.

1.4.1 Utilizing Project Lifecycles and Project Processes

Many projects may have subproject lifecycles within the larger overall project. For example, a decommissioning project may require a disposal facility—the subproject component. Therefore, breaking the subproject out and dealing with it as a design/construct project while performing the main project as a disposition project is the appropriate approach since both have different lifecycle phases. Project processes, as described in the PMI PMBOK®, have been developed and documented so that they can be aligned with most all project phases, however, some confusion can occur since the process areas (see below) have names which also sound like phases. Project processes have been generically organized into the following six overlapping phases (see Section 7, Project Planning, Integration and Reviews) by PMI:

- initiating
- Planning
- Controlling
- Executing
- Closing

While words like planning, execution, and mission broadly represent project phases and related processes, it is desirable to break them down into more specific subphases. In this manual, they are generally broken down into the following subphases:

- Preproject/preconceptual planning
- Conceptual design
- Preliminary design

PROJECT OVERVIEW

	Pre-Project	Preconceptual Planning	Conceptual Design	Preliminary Design	Final Design	Construction	Acceptance	Operations
PHASES	PROJECT PLANNING			PROJECT EXECUTION			MISSION	
				SPECIAL PROCUREMENT		REMAINING PROCUREMENT		
CRITICAL DECISIONS		APPROVE MISSION NEED CD-0	APPROVE PRELIMINARY BASELINE RANGE CD-1	APPROVE PERFORMANCE BASELINE RANGE CD-2	APPROVE START OF CONSTRUCTION CD-3		APPROVE START OF OPERATIONS OR PROJECT CLOSEOUT CD-4	
FUNDING	OPERATIONS COST (Non - Total Project Cost)		TOTAL PROJECT COST (TPC)					
			OTHER PROJECT COSTS	TOTAL ESTIMATED COSTS (TEC - WITH MINOR OPC)			OTHER PROJECT COSTS (WITH MINOR TEC)	OPERATIONS COST (NON - TPC)
				PROJECT ENGINEERING & DESIGN FUNDS (PED)				
MAJOR INPUT ITEMS	• Problem/Need Definition	• Document Proposed Modification • Conceptual Design • Decision Estimate & Budgets	• Permit Requirements • Facilities Scope • Preliminary Tech Dev Input • Readiness Assessment/Operational Readiness Review Applicability	• Approval of Preliminary Baseline Range • Project Authorization • Facility Scope Package • TPC & Schedule Range • Special Requirements	• Approved Baselines • Source Documents • Technology Development Output	• Issued for Construction Design Documents • Material and Equipment • Construction Permits	• Completed Systems	
MAJOR MILESTONES	• Establish Project Team • Establish Program/Project Planning Budget • Develop Project Scope • Identify Customer Expectations • Identify Key Schedule Drivers • Identify Funding Constraints • Identify High-Level Functions and Requirements • Identify Project-Level Interfaces • Identify Capital & Life Cycle Cost Drivers • Develop Conceptual Design Schedule Range • Develop Market Plan • Develop Up-Front Conceptual Design Business Decision Estimate & Budgets • Develop Pre-Conceptual Design Budget • Develop Pre-Conceptual Design Schedule • Establish Placeholder in Out-Year Budget	• Initiate Pre-Conceptual Planning & Design • Assess Technology Maturity Phase Plan • Submit CD-0 Package • Develop Project-Level Functions & Responsibilities • Identify Pre-Conceptual Risks • Perform Alternative Studies • Identify Long-Lead or Special Procurement • Establish Conceptual Design Budget & Schedule • Develop Preliminary Design & Sched Range • Develop Preliminary/Final Design Range • Develop Total Project Cost & Schedule Range • Prel Environmental Strategy • Identify Current & Next 2 FY Funding Requirements • Initiate Project Data Sheet for Design	• Perform Project & Detail Design Phase Technical and Programmatic Risk Analysis • Develop System-Level Functions and Requirements • Confirm Long-Lead Procurements • Develop Project Execution Plan for Preliminary Design • Set Project Execution Strategy • Site Investigation & Alternatives • Review Design Alternatives • Identify Project Codes, Standards and Procedures • Update Preliminary/Final Design cost estimate • Develop Preliminary Design Phase Budget & Schedule • Update Total Project Cost & Schedule Range • Perform Safety & Operability Review • Identify Current & 2 FYs Funding Requirements	• Define Special Procurement • Develop, Validate, & Issue Phased Package, if Necessary • Finalize Permit Requirements • Finalize Team Execution Plan • Commit Critical Equipment • Initiate Pulse Surveys • Perform Process Hazards Review • Project Site Selection • Update Project Execution Plan • Update Technical and Programmatic Risk Analysis • Develop Baselines • Develop CD-2 Package • Define CD-3 Deliverables & Completion Criteria • Update Annual/Outyear BA • Prepare Construction Project Data Sheet • Conduct External Independent Review • Conduct Independent Cost Estimate	• Receive Critical Vendor Data • Finalize 3D Computer Aided Drafting and Design Set-Up • Complete Design Model • Conduct Technical Innovations Evaluation • Finalize Planning Drawings • Finalize Field Support Plan • Review Safety Action Plan • Perform Final Design Review	• Start Site Work • Complete Procurement of Materials and Equipment • Start Systems Completion • Initiate Document Closeout Process • Work off Punch Lists	• Startup Commissioning Testing • Verification of Performance Criteria • Lessons Learned	• Financial Closeout • Satisfaction Meeting
MAJOR DELIVERABLES	• Market Plan • Conceptual Design Business Decision Estimate & Budgets • High-Level Functions & Requirements • Conceptual Design Schedule Range • Pre-Conceptual Design Budget • Pre-Conceptual Design Schedule	• Acquisition Strategy • Statement of Mission Need • Minimum Technical and Functional Requirements • Project Data Sheet for Design with Special Procurement Disclosure • Tech Task Request • Technology Dev Issues • Program Plan • Preliminary/Final Design & Prelim Schedule Range • Total Project Cost & Schedule Range • Mission Need Independent Project Review • Conceptual Design Budget & Schedule	• Acquisition Plan • Project Expectations Summary • Statement of Work • NEPA Documentation • Systems Engineering Mgmt Plan • Conceptual Design Package • Preliminary Project Execution Plan • Preliminary Hazard Analysis Report • Preliminary Team Execution Plan • Risk Management Plan • Preliminary Design Phase Budget & Schedule • Verification of Mission Need • CD-1 Package • Updated Total Project Cost & Schedule Range	• Review of Contractor Project Management System • Preliminary Design Detailed Schedules • Issued for Design Source Documents • Division of Responsibilities Matrix • Performance Metrics • Staffing Plans • Tech Risk Analysis Report • Technology Dev Output • Prelim Safety Analysis Report • Final Project Execution Plan • CD-2 Package • TPC Estimate • Independent Cost Estimate • NEPA Documentation • Project Data Sheet for Construction • Performance Baseline Independent Review	• Equipment and Material Requisitions • Issued for Construction Design Documents • 100% Definitive Estimate • Integrated Project Schedule and Subtier Schedules • Updated PEP & Performance Baseline • Final Design & Procurement Packages** • Verification of Mission Need • Budget & Congressional Authorization • Approved Safety Documentation • Execution Readiness Independent Review • Updated Construction Project Data Sheet	• Turnover & Startup Plan • Operating and Maintenance Manuals • Construction Completion • Startup Commissioning Test Plan • Final Safety Analysis Report • Annual Updated Construction Project Data Sheet	• Operational Readiness Review & Acceptance Report • Approval for Acceptance • As-Built Drawings • Final Safety Analysis Report • Project Completion Report	** To the degree appropriate for construction

Note: Deliverables from each phase are input to subsequent phases

Figure 1-1. Project Overview

- Final/detailed design
- Construction
- Acceptance
- Operations/mission/closure

All of the appropriate phases of a specific project should be identified and must be successfully planned, integrated, and executed by the project manager. Numerous examples, particularly Figures 1-1 and 2-3, are organized by phases. Examples of major inputs, milestones, and outputs are provided to assist the integrated project team in assuring comprehensive planning in developing the specifics of a project. Considerable experience has been incorporated into these examples and particular care should be given to ensuring that appropriate deliverables of one phase are complete prior to moving into the next phase.

All projects are inherently unique, so differences are expected, but when deviations are necessary from past lesson learned, clear understanding and management acceptance should be sought and documented.

1.5 Responsibility, Authority, Accountability

As used in this manual, project manager refers to the Federal project manager unless specifically identified as the contractor project manager. The Federal project manager has overall authority, responsibility and accountability for all assigned projects. In the following situations, however, the project management activities identified in this manual may apply to the contractor project managers:

a. When an M&I/M&O or other DOE prime contractor awards a project-related contract.

b. When management of contracts is identified in a DOE contract as an activity to be performed by the contractor.

c. When agreed upon between the Federal and the contractor project managers. Such agreements, however, must be in compliance with the terms and conditions of the DOE/contractor contract.

d. Any other project circumstances as agreed upon between the DOE and the contractor, provided such agreements do not violate contractual terms and conditions.

In the situations cited, the contractor's project manager becomes responsible for managing assigned project/subcontract activities and is delegated the necessary authority to accomplish the assigned work. Accountability, however, accompanies delegation of authority, and the Federal project manager still retains ultimate project responsibility, authority, and accountability—these cannot be totally delegated or abrogated. On the other hand, any responsibility delegated to either the Federal or contractor project manager must be inseparably linked with the authority necessary to accomplish the assigned task.

All agreements between DOE and a contractor clarifying project management responsibilities are documented in the Project Execution Plan and/or Memorandum of Understanding (MOUs). **If an MOU is used it shall be consistent with the PEP.** The federal project manager is responsible to assure all PEP/MOU requirements are met.

1.6 References and Requirements

The project manager ensures that the appropriate revisions of the applicable requirements documents, at the time the project performance baseline is approved (CD-2), are applied throughout the project. Application of later (following CD-2) revisions of requirements documents are approved through the project's change control system.

To assist the reader and to make this manual more "user-friendly," manual Requirements (i.e., shall statements) are presented in **bold** type. These requirements are also listed within the Practices, Appendix A, titled REQUIREMENTS. The requirements are cross-referenced to the manual by page and paragraph.

This manual contains specific References throughout. In addition, supplementary references and suggested reading are presented in the Practices, Appendix B: REFERENCES.

The acronyms used in this manual are listed in Appendix C of the Practices. Appendix C also included acronyms commonly used in the project management discipline.

The Practices also contain a Glossary. This definition of terms help assure that all manual and Practice users have a common understanding of terms and their usage.

2 PROJECT DEFINITION

During project planning, the bases/scope of a project are defined and developed. Typically, these bases include a

- Justification of Mission Need/outline project scope.
- draft Project Execution Plan (PEP).
- high level project design criteria or functional design criteria.
- preliminary cost estimate range.
- preliminary project schedule range.

These are normally prepared as part of a project's planning effort.

These "preliminary" initiation efforts develop and define/establish early project scope, schedule, and cost ranges, as a basis for follow-on project efforts; and, to demonstrate consistency with the DOE's strategic goals, plans, and objectives. An important secondary purpose is to assure that all organizations involved in developing the project are cognizant of and in agreement with the project as outlined and defined by these early project definition documents. A third purpose is to request and obtain CD-0, Approve Mission Need.

2.1 PROJECT PLANNING PHASE

The overall goal of the planning phase is to approve and develop an idea, need, or concept into a viable project with sufficiently valid scope, schedule, and cost information to enter the next phase of development.

2.1.1 Preconceptual Planning

A need or opportunity is identified that may be in response to a requirement developed or perceived by any entity: DOE, contractor, oversight organization, or the public. This need is developed into a concept or mission, and a program sponsor is sought/appointed. Historical information and technical data that support the mission concept is developed into a Justification of Mission Need document by the responsible program office. This documentation needs to include sufficient detail to enable reviewers to assess the need for and impacts of the proposed work. **In all cases, the Justification of Mission Need shall include**

- **a description of the conditions or regulatory requirements requiring action.**
- **benefits to the Department of Energy (DOE) and the public.**
- **alternative actions considered.**
- **an outline scope definition.**
- **planning/feasibility cost estimate.**
- **preliminary acquisition plan.**
- **planning/feasibility schedule(s) and milestones.**

At this time, if possible, a suitably experienced and qualified Federal project manager is identified, and the Integrated Project Team (IPT) is organized. Approve Mission Need (CD-0) allows a proposed project to proceed to conceptual design.

2.1.2 Conceptual Design

If not already in place, a Federal project manager is nominated and appointed, and operating or expense money is provided for the conceptual design effort. This effort is contracted or added to the site prime contractor's contract. In this case, a responsible contractor's project manager is appointed. The IPT is further developed to encompass the Program Secretarial Office (PSO) management and other support staff, as appropriate. **The IPT shall also include the contractor project manager.** The purpose of a "living" IPT is to assure IPT membership and associated skills reflect and support the changing project phases. In later phases this team expands or contracts, but the concept of working together as an integrated unit will be fostered and retained. The type of project proposed will generally dictate the rigor imposed on the conceptual design, and may extend to testing of materials or processes, depending on the complexity of the proposed project.

In addition to the conceptual facility/equipment design culminating in a Conceptual Design Report (CDR), a draft Project Execution Plan (PEP) is developed. The PEP describes or references safety, quality, and environmental requirements. Integrated with the PEP are draft Contracting and Procurement, Project Risk

Assessment, Safety, and Quality Plans—all support managing the project as well as the request for CD-1.

The PEP will specify all documentation and the level of completion required to be provided for CD-2, Approve Performance Baseline. For nonremediation work, Project Data Sheets (PDS) are also developed. The PDS, which requests capital funding, may, however, be delayed until additional design work is completed. **Project documentation shall support the request for CD-1, which establishes the project's preliminary schedule and cost baseline ranges.** At this time, the project undergoes a validation process (Verification of Mission Need) to confirm that the scope, cost, and schedule estimates are compatible. With appropriate approvals, the project moves into the Project Execution Phase. Details of the PEP, and validation review are provided in Section 7, Project Planning, Integration, and Reviews.

2.1.3 Preliminary Project Execution Planning

With the completion of the Project Planning phases, those documents required to obtain Critical Decision-1 (CD-1, Approval of Preliminary Baseline Range) approval shall also be completed, approved and provided. These include

- **an Acquisition Plan.**
- **a Conceptual Design Report.**
- **a Preliminary Hazard Analysis Report.**
- **a Preliminary Project Execution Plan.**
- **a design funding estimate.**
- **preliminary baseline ranges for scope, schedule, and cost.**
- **a Project Data Sheet for design.**
- **a Verification of Mission need.**

The initial safety and environmental impacts, functions, and requirements; alternative analysis and trade off studies; technology development needs; and risk management plans are useful in developing these documents.

The preliminary project scope shall be defined in a Work Breakdown Structure (WBS) and WBS dictionary that are developed based on the project's

major elements and deliverables. The WBS facilitates additional planning and controlling of work scope and should reflect the way the work will be performed and managed. **Project cost and schedule ranges shall be developed based on the project WBS.** At this point in the project, the WBS will not be of sufficient detail to support a definitive performance baseline.

As required by DOE O 413.X, in conjunction with the CD-1 submittal, these documents shall be submitted for SAE/AE approval.

Where long-lead procurement is required to support a project, a phased CD-3 may be requested at this time.

2.2 EXECUTION PHASE

In the execution phase, preliminary concepts are further defined and developed into design documents that may be used to procure or manufacture components, fabricate large systems, or construct facilities. At this point, (1) reporting requirements and baselines for project control are established and maintained, (2) environmental and safety requirements are satisfied, and (2) the final design configuration is approved.

This phase is subdivided into two segments: design and construct/fabricate or plan and remediate. During design, the project is subject to peer or independent reviews and the use of value engineering techniques to ensure the appropriateness and cost effectiveness of the design output. Again, these activities should be tailored to the size, complexity, and needs of the project. Safety, environmental, and quality plans and requirements are to be maintained throughout the process. **The project manager shall not to commit to the performance of any tasks without confirming the availability of funds.**

2.2.1 Preliminary Design

Using the products of the conceptual design, this task initiates the development of a design that is adequate for procurement and construction. This phase of the design is complete when it includes sufficient information to support performance baseline development. Generally, this is roughly equivalent to 20 to 35 percent of the total design effort. During preliminary design the following occurs in support of the request for CD-2:

1. Technical scope, schedule, and cost performance baselines are developed and become the input for the CD-2 request.
2. Cost and schedule performance are maintained for the design task.
3. Total Estimated Costs (TEC) and Total Project Costs (TPC) are monitored and controlled through the change control process as final baselines are developed.
4. The PEP is updated and issued.
5. Safety, quality, and environmental documentation are refined.
6. Project data sheet for construction is prepared.
7. Review of contractor's project management system is performed.
8. Performance measures for the contractor's performance are finalized.
9. An Independent Cost Estimate (ICE) is performed to further validate the cost/scope relationship.
10. A performance baseline external independent review is performed.

With this information, the project progresses to CD-2, Approve Performance Baseline.

2.2.2 Final Design

The remaining 70 percent of the design consists of finalizing work under way and then producing and releasing construction and procurement documents/packages. As the design is finalized, the PEP, scope of work, cost estimates and schedules are updated and documented through the change control process. Even through considerable detailed design remains to be done, the 30 percent will support solid cost and schedule estimates. Justification of Mission Need is again reviewed, particularly with respect to changing conditions that are not within the control of the project, such as overall site priorities, new technologies, change in cleanup strategy, changes in planned funding, and so forth.

2.2.3 Construction

With the design complete, the project is ready for CD-3, Approve Start of Construction. Construction and procurement are now initiated. Wherever appropriately supported, fixed-price contracts are issued. Performance is measured in terms of cost, schedule, scope, and contractor role. Approved and validated project baselines, completed designs, and energetic-management control significantly mitigate problems during this phase of DOE projects, especially those unique projects having specialized equipment and processes.

As described in Section 14, Project Controlling, rigorous change control helps control scope creep which in turn controls schedule and cost creep. The requirement to report the project and budget status continues throughout construction completion, operational testing, final acceptance, and turnover of the facility (or equipment) to the user. At this stage, the project is ready to progress to CD-4, Approve Start of Operations or Project Closeout. A key part of obtaining CD-4 is the delivery of appropriate project-related documentation that supports the start of operations.

2.3 Mission Phase

The Mission Phase is considered the Operations Phase. At this time, the project is complete and the facility is turned over in an operational state to the user, and planned operations continue until the mission is accomplished. Program operations funds are used to operate and maintain the facility until the end of its useful life when it is decommissioned. For Environmental Management (EM), the project may be turned over to operate during the remediation phase.

2.4 Environmental Management Projects

As defined in the EM Integrated Planning Accountability System Handbook, some Environmental Management (EM) projects do not necessarily have the same acquisition phases as conventional projects. To determine the step-by-step process by which EM projects are acquired, it is first necessary to determine the type of projects being initiated. This is determined through a site evaluation that reviews for the entire site: historical records, production reports, audit reports, interviews with operations personnel, and so forth, with the intent of identifying all areas that might be contaminated from past activities. These sites could be grouped together to form operable or waste units based on geographic location, type of contamination, or a regulatory driver, or some other criteria that is agreeable to the responsible organization. **Remediation of operable or waste units shall be accomplished through establishing and executing projects**. The EM has divided its work into the following categories:

- EM Conventional Projects
- Environmental Restoration (ER) Projects
- Facility Disposition Projects (transition, deactivation, and decommissioning).

Except where it is consistent with information already presented, each phase of the acquisition process is described in the follow subsections.

Critical Decisions for Environmental Restoration Projects

Planning Phase		**Execution Phase**		**Post-Closure Phase**
Site Evaluation	**Characterization, Feasibility Reviews and Remedy Selection**	**Engineering**	**Construction/ Remediation**	**Closeout or Stewardship**

★ **CD-0**	★ **CD-1**	★ **CD-2/3**	★ **CD-4**
Approve Mission Need	Approve Preliminary Baseline Range	Approve Start of Construction Remedial Action	Approve Preliminary Baseline Range

Figure 2-1. Critical Decisions for Environmental Restoration Projects

2.4.1 EM Conventional Projects

EM work that may be categorized as conventional shall be projectized and managed as a separate project. The acquisition process is the same as a conventional project, except there are often more regulatory drivers that initiate the project activity.

2.4.2 Environmental Restoration (ER) Projects

Restoration projects are executed in accordance with applicable federal and state regulatory requirements including Resource Conservation and Recovery Act (RCRA), Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and tri-party agreements (e.g., Federal Facility Agreement). The phases of ER activities and their relation to critical decisions (CDs) are presented in Figure 2-1 and discussed in the following sections. It should be noted that ER projects for a specific waste site often contain multiple subunits with various remedies (e.g., interim actions and removal actions) that may result in multiple CDs for each phase. Multiple subunits will be documented in an appropriately tailored Project Execution Plan (PEP).

2.4.2.1 Planning Phase

The goal of the planning phase is to identify the contaminants associated with a potential waste site and determine if the site requires further characterization and remediation. This process includes initial identification through the Preliminary Assessment (PA)/Site Investigation (SI) phase of CERCLA, the RCRA Facility Assessment (RFA) phase of RCRA or other identification process and progresses through the applicable regulatory steps to enable sufficient scope, schedule, and cost estimates to be developed.

Site Evaluation

A thorough site assessment helps determine the type of remediation, if needed, that will be required and the type of project required to implement the remediation. An evaluation should include reviews of historical records and maps, production reports, operator logs and reports, audits, interviews with knowledgeable personnel, etc. Based on the results of these efforts, sites can be prioritized and organized into projects that will result in the most cost-effective solutions.

Characterization, Feasibility Reviews, and Remedy Selection

Characterization is the second step in the planning phase. This step involves quantification of the nature and extent of contaminants present at a site and the associated risks of the contaminants to human health and the environment as well as the identification of remedial alternatives that will meet the identified preliminary remedial goals. The alternative methods are screened and technically evaluated during the Feasibility Study (CERCLA) or Corrective Measures Study (RCRA). The preferred remedial alternative is then presented to the regulators in the form of either a Proposed Plan (CERCLA), Statement of Basis (RCRA), or other regulatory document. After approval by the appropriate regulatory agency or agencies, these documents are subject to public notice and comment as mandated in the appropriate regulations. Public meetings can be held to address any significant issues or concerns that the public might have regarding the proposed alternative. After the public participation requirements are complete and changes, if any, have been incorporated, a Record of Decision (ROD) or RCRA permit modification is prepared, as appropriate. These documents specify the remedy and implementation schedule agreed to by the US DOE, US EPA, state, Tribal Nations, and other stakeholders. However, in some cases, partial remedial decisions are made and implemented while the final remedial decision is pending. This approach can increase the risk of significant changes to the project scope but does allow early implementation of components of the remedy, which in turn can reduce costs significantly. These early or interim actions may mitigate an immediate human health or environmental hazard or provide an integral step prior to implementing the final action. Planned approaches should be clearly documented in the PEP.

2.4.2.2 Execution Phase

Completion of characterization and approval of CD-1, Approve preliminary baseline range, allows the planned remediation to move into the execution phase. Typically, the schedule range for remediation has been predetermined during the characterization step.

Approved plans are further defined and field, bench, or treatability testing may be performed in this phase. Baselines for project control are developed, and reporting is initiated per pre-established requirements. All environmental and safety requirements are satisfied, and the final design configuration is approved. Required regulatory documents, plans, designs, and permits, as required, are submitted and must be approved by the appropriate agencies prior to implementation.

Engineering

Studies conducted during this phase establish the technologies or processes necessary to remediate the particular site in accordance with the requirements established in the ROD or RCRA permit. Activities may include treatability (proof-of-principle) studies, additional characterization, establishment of project technical requirements and design criteria, hazard analysis, and finalization of the regulatory and permitting requirements. A portion of these activities may have been performed prior to CD-1 as part of the characterization step.

During engineering the following activities are performed:

- Safety documentation is prepared and approved (e.g., health and safety plans).
- Engineering completed (e.g., design drawings, specifications).
- Environmental documentation is prepared and approved (e.g., National Environmental Policy Act evaluation).
- Third-party concurrence obtained (e.g., public notices).
- Construction requirements are developed (e.g., waste management plan).

Often the environmental restoration design is defined in specifications sufficient to allow the work to be contracted/subcontracted. Corrective Measures/Remedial

Action Implementation Plans specifying the design are submitted to the regulators, and with regulatory approval, construction/remediation may begin. Before construction begins, however, the plans, specifications, and all other documentation will be used as input to CDs 2/3. Approval of CDs-2/3 will move the project into the construction portion of the execution phase, which must be accomplished in accordance with the statutorily mandated schedules.

Construction/Remediation

There are essentially two types of ER construction projects: those where the remedial action is actually accomplished by the construction activity (e.g., engineered cap, excavate and dispose, soil grouting), and those that construct a facility that will complete or perform the remediation (e.g., wastewater treatment facility).

For ER projects where the remedial action is accomplished by the construction activity, the execution phase is completed when construction is complete. For remedial actions requiring the construction of treatment facilities, the execution phase is complete after the operating facility is constructed and successfully turned over to an operations entity.

2.4.2.3 Post-Closure Phase

Post closure is the final phase in the acquisition process for an ER activity. Depending on the activity, there may be a discrete closure or the site/facility may be turned over for long-term stewardship, which may include operation, maintenance, and monitoring in accordance with the ROD, Closure Plan, or equivalent. The acquisition would be considered closed upon successful turnover.

2.4.3 Facility Disposition Projects

Facility disposition projects address the decommissioning of surplus contaminated facilities. Decommissioning activities involve the decontamination and safe disposition of facilities that have been deactivated. Safe disposition may include

- reuse of a decontaminated building.
- demolition of a facility, with rubble removed from the site.
- entombment which might involve collapsing a structure and capping the contaminated rubble in place.

Facility disposition projects follow a decision-making process similar to that of Environmental Restoration projects characterization, followed by detailed analysis of alternatives and a formal remedy selection. However, there are differences to be considered, as shown in Figure 2-2.

Critical Decisions for Facility Disposition Projects

Project Planning Phase		**Project Execution Phase**			**Mission**
Preconceptual Planning	**Conceptual Design**	**Preliminary Design**	**Final Design**	**Construction**	**Operations**
★ **CD-0** Approve Mission Need		★ **CD-1 / CD-2** (Combined Decision) Approve Performance Baseline	★ **CD-3** Approve Start of Construction or Remedial Action	★ **CD-4** Approve Start of Operations or Project Closeout	

Figure 2-2. Critical Decisions for Facility Disposition Projects

► ***Project Planning Phase***

The goal of this phase is similar to that of ER: identification and development of a process for facility disposition from initial facility identification, characterization of the problem, identification of a preferred solution, performance of an environmental review, engineering the solution, and finally implementing the design.

Facility Identification

The initial step in the planning phase for disposition projects includes formal identification of the facilities that are ready for disposition and acceptance of responsibility by the appropriate project organization. This step is equivalent to Mission Need and is documented by CD-0. After turnover from operations, facilities are normally kept in a surveillance and maintenance mode until ready for final disposition. Because of the large number of facilities with limited funding, and low priority, S&M on most facilities often last for a considerable period.

Characterization

A facility shall be characterized for types and amounts of contamination, alternative corrective actions developed, and the preferred alternative selected. Whereas ER projects use the RCRA or CERCLA guidance to formalize the process, facility disposition projects normally use the NEPA process to accomplish the same result. This process results in the preparation of either an Environmental Impact Statement (EIS) or an Environmental Assessment (EA). The resulting decision is (1) documented in the form of a ROD for an EIS, Finding of No Significant Impact (FONSI) for the chosen approach treated in an EA or (2) defined in a Categorical Exclusion (CX) description. (This phase is considered complete with the approval of the NEPA documentation.)

Approval to start detailed design (project execution phase) in accordance with the NEPA decision, is documented by CD-1/CD-2, Approve Performance Baseline.

- ***Project Execution Phase***

  Except for minor differences in terminology, the execution phase for facility disposition is the same as that for ER projects such as, preliminary design, final design and construction/disposition. (Approval of final design and readiness to proceed with disposition is documented by CD-3, Approve Start of Construction or Remedial Action.)

- ***Mission Phase***

  During the mission phase, remedial actions begin and project closeout documentation is prepared. If appropriate, an independent verification contractor makes the necessary reviews and field checks to verify that specified end conditions have been met. (CD-4, Approve Start of Operations or Project Closeout, documents approval to begin this phase.)

  If appropriate, long-term surveillance and maintenance or other institutional controls may continue after the project is considered complete.

2.5 DOCUMENTATION

A significant number of required documents must be developed and issued during the life cycle of a project. These documentation activities begin prior to preconceptual design and are not completed until after project closure. Figure 2-3 depicts the typical stages of a project and a large sampling of the potential documentation needed to support moving to the next phase. Many of the identified documents are not only integral to project development but are necessary for the project to proceed from one phase to the next.

Preconceptual Design	Conceptual Design	Preliminary Design	Final Design	Construction, Startup/ Turnover
Cost: DOE approval if conceptual design costs exceed $600,000 limit **Maturity:** Need to know estimated conceptual design cost	**Cost:** DOE Authorization **Maturity:** Need cost range estimate of Preliminary Design; Target Project Cost	**Cost:** Congressional funding **Maturity:** Project performance TEC and TPC performance baseline including contingency at CD-2	**Cost:** No special requirements to go from final design to construction—under change control **Maturity:** CD-3 pre-construction release	**Cost:** No requirements—under change control **Maturity:** CD-3 released, CD-4 complete at closeout
Schedule: No schedule requirements to go from Pre- to Conceptual Design	**Schedule:** DOE Approval **Maturity:** Need Preliminary Design schedule	**Schedule:** Project schedule **Maturity:** Project TEC/TPC	**Schedule:** No special requirements to go from final design to construction—under change control **Maturity:** Not Applicable	**Schedule:** No requirements—under change control **Maturity:** Not Applicable
Technical: Support the Conceptual Design Estimate **Maturity: *** • Assessments and studies • Design Criteria (Orders, regulations, codes & stds.) • Functions • Identify Technology Development activities • Information Utilization Strategy • Mission • Operational Strategy and Automation Strategy • Performance Requirements • Preliminary Vulnerability Assessment Study • Preliminary Site Clearance Permit • Review of Alternatives • Risk Assessment • Site Selection Criteria • Small-Scale testing • Systems Engineering Management Plan	**Technical:** Support cost and schedule and Conceptual Design Report (CDR) **Maturity: *** • Alternative Studies • CDR • Complete Facility Design Description, approve Facility Functional and Operational Requirements, and draft Program Requirements • Complete system design description • Conceptual Vulnerability Assessment Study • Develop Key Technical Parameters • Identification of system boundaries • Identify engineering development versus proven process • Identify permitting requirements • Draft Interface Control Documents (ICD)	**Technical:** Engineering development completed, with contingency for open issues **Maturity: *** • Complete Accident Analysis • Component requirements identified • Configuration Mgmt. Plan • Facility Design Description completed • Final Characterization and Site Selection • Initiate Pressure Protection Plan • P&ID Rev. 0 • All Construction and Procurement Packages Complete • ICDs issued • Preliminary layout drawings of major components • Performance Verification a) Full-Scale Tests b) Refinement/Optimization —Engr.-Scale Tests —Integrated Runs • Material Balance	**Technical:** Complete design documentation **Maturity: *** • All detailed design drawings, calculations, specifications, etc., except field run items • Test Plans Issued • Construction Punchlist • ORR Planning and Preparation developed • Finalize Pressure Protection Plan • Site Clearance Permit • Testing requirements identified • All construction and procurement packages complete • ICDs issued	**Technical:** **Maturity: *** • All as-builts complete • Performance Verification a) Operating Parameters Definition b) Process Optimization • Task plans issued • ORR Planning and Preparations

Preliminary Design Authorized →
Project Baselines Established as TEC and TPC →
*Technical Maturity – those applicable deliverables necessary to proceed to the next project phase

Figure 2-3. Project Documentation by Typical Phases

Preconceptual Design

Technical Maturity continued: *
- Technology Development Program Plan
  a) Program R&D requirements
  b) Define R&D program phase

Safety and Hazard Analysis / Vulnerability Assessments
- Draft Safeguards Requirements Identification
  Supported by:
  —Preliminary VE Study
  —Hazard Assessment Document
  —Proposed Process Material Flow
- Emergency Preparedness Hazard Survey and Screen
- Hazard Assessment Document (HAD)
  Supported by:
  —Facility layout
  —Hazardous material inventory

Conceptual Design

Technical Maturity continued: *
- Identify preliminary structures and systems with preliminary safety classifications
- Information Utilization Plan
- Operational/Automation Plan
- Preliminary Characterization and Site Selection
- Proof of Concept Testing
- Regulatory Management Strategy
- Risk Management Plan
- NEPA (EA, EIS approved)

Safety and Hazard Analysis / Vulnerability Assessments
- Preliminary Functional Classification
  Supported by:
  —Preliminary Hazards Analysis
  —Selected Alternative Study
- Preliminary Shielding Analysis
  Supported by:
  —Facility layout
  —Radiological material location
- SRI, Rev. 0
  Supported by:
  —Conceptual VE Study

Preliminary Design

Technical Maturity continued:*
- Reliability, Availability, Maintainability Evaluation
- System Design Description at system level
- System boundaries identified
- Technology Development activities complete
- Updated Risk Management Plan
- Value engineering

Safety and Hazard Analysis / Vulnerability Assessments
- ALARA Review
  Supported by:
  —Preliminary Design
- Automation and Information Design approach finalized
- PSAR Rev. A
- Preliminary Emergency
- Preparedness Hazard Assessment
  Supported by:
  —PSAR Rev A
  —Preliminary Design
  —Project Cost Estimate

Final Design

Safety and Hazard Analysis / Vulnerability Assessments
- Accident Analysis
  Supported by:
  —Final Design
  —Final Functional Classification
- Basis for Interim Operations
- Criticality Analysis
  Supported by:
  —Final Design
  —Draft Vulnerability Assessment Report
  —Final Functional Classification
  —Administrative Controls
  —Final Hazards Analysis
  —Accident Analysis
  —Criticality Analysis
- Final Shielding Analysis
  Supported by:
  —Final Design
- Fire Hazards Analysis
  Supported by:
  —Final Design
  —Final Functional Classification
- Preliminary technical safety requirements
- PSAR Report
  —Emergency Action Levels

Construction, Startup/ Turnover

Safety and Hazard Analysis / Vulnerability Assessments
- Emergency Preparedness Hazard Assessment
- Final Fire Hazard Analysis
  Supported by:
  —Final Drawings
  —Walk down
  —Tests
- FSAR
  Supported by:
  —As-builts
  —Final Hazards Assessment
  —Startup test results
  —Site Safeguards and Security Plan
  —Safeguards and Security Management Report
  —Final Vulnerability Assessment Report
  —Tests (force on force)
- Technical Safety Requirements
  Supported by:
  —FSAR

Preliminary Design Authorized → (through Preliminary Design)
Project Baselines Established as TEC and TPC → (through Final Design)
Technical Maturity – those applicable deliverables necessary to proceed to the next project phase
Permit Applications and Approval → (through Construction, Startup/Turnover)

3 INTEGRATED SAFETY, ENVIRONMENTAL, AND QUALITY MANAGEMENT

A key component of the successful project is that safety, health, environmental, and quality issues are addressed early in a project's life-cycle and fully integrated into all project activities. The responsibility for safety, health, environment, and quality is a line management responsibility, owned by the entire project team, starting with the project manager. An Integrated Safety Management System (ISMS) is most effective when developed early and implemented in project planning, project design, construction, testing, and operation. An ISMS is an overall management system designed to ensure that environmental protection and worker and public safety is appropriately addressed in the planning and performance of any task. The fundamental premise of Integrated Safety Management (ISM) is that accidents are preventable through early and close attention to safety, design and operation, and with substantial stakeholder involvement in teams that plan and execute the project, based on appropriate standards. During the design phase, the project has the unique opportunity to eliminate or minimize hazards, and incorporate cost-effective accident prevention and mitigative design changes. This includes taking a fresh look at the reference design to provide safety through design. Implementation of safety, health, environmental protection, and quality, therefore, cannot be through independent programs but needs to be fully integrated based on ISM principles and project plans, programs, and procedures. Integration must occur no later than the initiation of conceptual design.

Throughout this manual, the term safety encompasses protection of the public, the workers, and the environment. Quality is a critical element of an ISMS and is integrated into the project management programs along with safety, health, and environmental protection program requirements. This section first discusses integration of safety, health, environmental protection, and quality into the project management systems via an ISMS. Although encompassed by ISM, the specifics and unique assets associated with meeting safety, environmental protection, and quality requirements, including required documentation, are then described individually..

3.1 SAFETY

A primary and continuous responsibility of project management is safety. This includes safety of project personnel, as well as those that will operate or maintain the facility, or that could otherwise be affected by the decisions made during the project planning, design, construction, and testing stages. This responsibility begins at the time a project or remedial action is planned and continues until project or remedial action is completed. As the project manager develops and maintains project baselines, the focus is on providing a safe quality design.

Department policy DOE P 450.4 requires that safety management systems be used to systematically integrate safety into management and work practices at all levels so that missions are accomplished while protecting the public, the worker, and the environment. Integrated Safety Management (ISM) is required as part of DOE management of projects. As stated in DOE P 450.4, *Safety Management System Policy,*

> *This is to be accomplished through effective integration of safety management into all facets of work planning and execution. In other words, the overall management of safety functions and activities becomes an integral part of mission accomplishment.*

This policy requires that ISM functions and principles apply to all project and remedial action activities through all phases of these efforts. Ensuring adequate protection of the public, workers, and the environment is an essential part of selecting the integrated project team and performing project activities, including project planning, design, technology development, construction, testing and turnover, and facility disposition. Each of these key areas is discussed in later subsections.

Project management, in using ISM, ensures that work processes related to design are executed with attention to safety; and that work processes related to research, development, testing, use of hazardous materials, and construction techniques are executed with proper controls. This section will describe how ISM functions and principles are to be applied to the execution of a DOE project during each of its stages. DOE is committed to conducting all work on its projects so that missions can be accomplished with adequate controls in place to protect workers, the public, and the environment. For those facilities that contain, or will contain, hazardous materials, continuous development and integration of safety analysis as an integral part of design is required. In other words, the fulfillment of safety functions by systems and structures becomes an integral part of fulfillment of project and mission functions.

The ISMS, along with the basic assumptions regarding quality and the specific requirements for the project from DOE, provide a framework under which the Project Execution Plan (PEP) and lower-tier documents such as implementation plans and procedures are developed. If the project is covered by an existing DOE site ISMS, then that governing site ISMS should be implemented within the project. If an existing ISMS can be used or modified to accommodate the project, then it is recommended that the project implement the site program through the PEP. If the project includes multiple companies, additional ISMS documentation may have to be developed to demonstrate compliance within each of these organizations with the specific project ISMS requirements.

3.1.1 Integrated Safety Management System

An ISMS is a system designed to ensure that environmental, worker, and public safety is appropriately addressed in the performance of any task. A fundamental premise of ISM is that accidents are preventable through early and close attention to safety, design, and operation, and with substantial stakeholder involvement in teams that plan and execute the project, based on appropriate standards. The ISMS consists of (1) the objective (2) the guiding principles (3) the core functions (4) the mechanisms of implementation (5) clear responsibilities for implementation and (6) implementation. As such, an ISMS is characterized by a management system's ability to implement the five core management functions and seven guiding principles using the key implementing factors as described below.

To implement ISMS, the project needs to have a commitment to a standards-based safety program. Articulation of these objectives and principles is important, but not sufficient, to achieve effective safety management. The challenge to establishing a standards-based safety approach in a project is to provide the rigor associated with the standards, yet provide the flexibility to apply a hazards-based tailored approach to defining the requirements. ISMS, as an integral part of project management, ensures that work processes related to design, testing, and construction are planned and executed with proper controls and with appropriate attention to safety.

The successful safety system functions effectively within safety mandates, considering budget and resource limitations. It enables tailoring so that hazards are identified and controlled, yet maintain the design, planned operation, and project tasks not burdened with inflexible, prescriptive controls that needlessly inflate costs, and constrain the project, and do not enhance safety. Thus, tailoring within project management functions (planning, analyzing hazards, establishing controls, performing tasks, assessing implementation, and providing feedback) should enable tasks to be managed at the appropriate levels. In effect, management systems function to optimize task planning and performance to enable those closest to the task —those who perform the task, those who manage or supervise it, and those who will be affected by the results—plan, and assume responsibility for it.

To assure that the design provides a facility that facilitates safe operation and will not have open safety issues at project startup, safety and environmental issues need to be identified and addressed early. Proper ISMS implementation ensures that both design and physical work are performed with proper attention to potential hazards, regardless of the type of activity being performed.

3.1.2 Integrated Safety Management Through Design

Addressing safety issues early permits a design for safety approach within the project. The goal is to ensure that safety is "designed in" early instead of "added on" later with increased cost and decreased effectiveness. Safety through design is not just meeting the specified safety requirements in the design; it is the project team taking specific actions regarding safety. It includes making design changes to eliminate hazards, minimize hazards, mitigate consequences, and preclude the events that could release the hazard. Addressing hazards with a safety through design approach does not always require that systems, structures or components be added that will prevent or mitigate the releases. It may involve removing or moving systems or changing approaches to the design that result in a safer facility and improved operations. It may result in fewer safety class and safety significant controls being required in the final design.

For nuclear facilities, the integration of anticipated hazards into the facility design requires special considerations. DOE has established the Safety Analysis Report (SAR) or the Hazards Analysis Report (HAR) as the preferred method for authorizing operation for its most hazardous facilities. The SAR also provides a critical feedback mechanism for the project. To assure integration of safety and design the documents that support SAR preparation (e.g.; Hazards Analysis Document, Fire Hazards Analysis, Emergency Response evaluations, etc.) need to be initiated early and developed along with the design. ISM provides the framework to provide continuous coordination between these two activities is necessary throughout the design process to ensure the final design meets both mission and safety requirements.

3.1.2.1 Objective

The project objective is to systematically integrate safety into management and work practices at all levels and at all stages of the project so that missions are accomplished while assuring protection for the public, the worker, and the environment. This is accomplished through effective integration of safety management into all facets of project planning and execution, such that the overall management of safety functions and activities become an integral part of the project. The ISMS description needs to address the project roles and responsibilities for the designer, the constructor, and the startup operator during each phase of a new facility development. Due to the changing need in each area, the project manager needs to assure that appropriate coverage is provided from these areas on the IPT for each phase of the project.

3.1.2.2 Guiding Principles

The ISM Guiding Principles and Core Functions provided in DOE P 450.4, Safety Management System Policy, shall be applied to ensure that safety is integrated into design. These principles as they relate specifically to project management and the design process are:

- Line Management Responsibility for Safety: Project management is directly responsible for ensuring the facility structures and systems, or the remedial activities recovery actions, protect the public, the workers, and the environment.
- Clear Roles and Responsibilities: Clear and unambiguous lines of authority and responsibility for ensuring safety is integrated into facility design/remedial action planning are established and maintained at all organizational levels within the Department, the project, its contractors, and its suppliers.
- Competence Commensurate with Responsibilities: Project personnel need to possess the experience, knowledge (including project procedures and controls), skills, and abilities that are necessary to discharge their responsibilities. Facilities, including those that contain, or will contain, hazardous material, require specific competencies including hazard analysis, accident analysis, safety system design, QA, facility construction, and facility operation and maintenance, which are tailored based on risk.

- Balanced Priorities: Safety, programmatic, and operational requirements need to be effectively fulfilled by facility features. **Protecting the public, the workers, and the environment shall be a priority for all new design, construction, modification, or remediation.**

- Identification of Safety Standards and Requirements: The project manager should assure the hazard evaluation process is initiated early and continued throughout the project. Before detailed design is performed, the associated hazards must be evaluated and an agreed-upon set of safety standards and requirements established which, if properly implemented, will provide adequate assurance that the public, the workers, and the environment are protected from adverse consequences of facility operation.

- Engineered Controls Tailored to Function Being Designed or Performed: Engineering controls that are designed to prevent and mitigate hazards are tailored to the facility function or the remedial activity and the associated hazards.

- Approval to Proceed: Design reviews are performed to verify that safety has been adequately integrated into the evolving design before approval is given to proceed to the next design phase, procurement, construction, or operation.

3.1.1.3 Core Functions

The expectations for an integrated safety management approach can be described by a successive set of actions or activities. This management system is modeled by the five core safety management functions; adopted as shown below to reflect the design process:

Define the Work	↔	Baseline Scope of Work
Analyze the Hazards	↔	Analyze Potential Hazards
Develop and Implement Hazard Controls	↔	Develop Design Controls/ Requirements
Perform Work within Controls	↔	Perform Work/Design
Assessment and Feedback	↔	Review, Feedback, Improvement and Validation

The five core safety functions are illustrated in Figure 3-1. Although the arrows indicate a general direction, these are not independent, sequential functions.

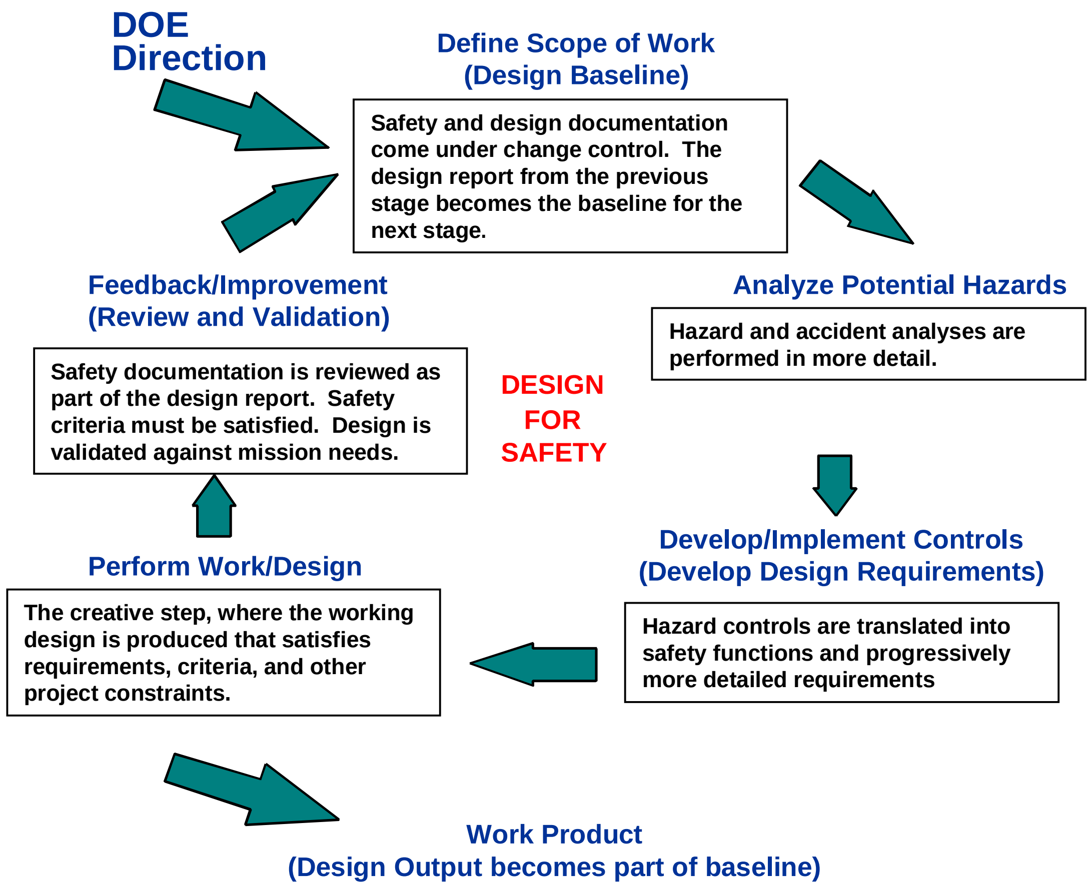


Figure 3-1. Safety Aspects in a Typical Design Stage

Baseline Scope of Work

During each design stage, safety and design documentation are progressively developed, become more detailed, and the additional detail, comes under change control. The design report from a previous stage becomes the baseline for the next stage.

Analyze Potential Hazards

Hazards and accidents are analyzed in progressively more detail in each design stage. Safety analysts must work closely with project engineers to develop a common understanding of the facility, systems and processes, possible hazards including hazardous materials, and the envisioned operation of the facility.

Develop Design Controls/Requirements

Hazard controls are translated into safety functions and progressively more detailed requirements affecting the facility design. Hazard analysis and accident analysis (if needed) will identify aspects of process and facility design necessary for safety, as well as systems that are dedicated to the fulfillment of necessary safety functions. In addition to physical controls, Administrative Controls required to provide or support the safety functions are identified.

External constraints, such as laws, rules, codes, standards, and contracts are examined for their applicability. Relevant criteria and requirements are extracted and entered into the project-specific design manuals.

Perform Work/Design

While not always visible as a discrete function in the process, design is the "creative" function of the process where the architect/engineer produces a working design that will satisfy requirements, criteria, and other constraints. The working designs are committed to "paper" and assembled into a design package that constitutes the output of this stage and comes under configuration (change) control.

Review, Feedback, Improvement and Validation

This function consists of unscheduled (lower-tiered) reviews and (upper-tiered) scheduled critical decision reviews. Safety design is specifically included in the review, and safety review criteria are established for each stage. The review criteria for earlier stages are reexamined in each stage to ensure corrective actions from prior reviews have been taken and those changes have not invalidated earlier reviews. For nuclear facilities, general criteria are identified for each stage of design and construction in the detailed description of each stage given in the Practices. These criteria should be adapted and used, as relevant, for specific projects. The process of developing the safety documentation (e.g.; SAR) provides a valuable feedback and improvement mechanism for this function.

3.1.3 ISMS Implementation for Project Management Activities

As previously described, ISM is an essential part of all project activities. The guiding principles and core functions of ISM should be utilized throughout each project. This section discusses applying ISM to some key project activities, project planning, design, technology development, construction, and facility disposition. To assure project execution planning appropriately addresses the interactions between the seven principles and five core functions, a crosswalk of guiding principles and core functions against implementation within the procedures and practices is helpful. This crosswalk provides a valuable tool for project management to assure the implementation procedures address ISM functions and principles. A continuing focus of ISMS implementation is to assure that the stakeholders are fully and appropriately involved with the current phase of the project or detailed planning for the next phase.

3.1.3.1 Project Planning

Project planning should include early identification of potential hazards. For nuclear facilities, activities recommended in DOE G 420.1-1, section 2 will be conducted at the appropriate stages of the design. The PEP should include a section that addresses ISM implementation within the project. A principle of project planning is that it be routinely evaluated to assure that all areas are fully integrated and that changes in one area are reflected in other areas. A valuable safety communications tool for projects with hazardous facilities (those categorized above Hazard Category 2), is the lower-tier safety analysis and documentation plan. The plan may be used to communicate the level of safety documentation that will be available at each critical decision point in the project. Early agreement on the level of safety documentation by phase, both the project and regulating body not only supports project planning, but minimizes regulatory issues later in the project. The Practices provide an example of one of these plans and the level of documentation for a relatively complex facility. For small, less complicated scopes, this safety planning may be effectively covered in the PEP.

3.1.3.2 Integrating Safety with Design

Delivering a facility or a modification that can meet its mission requirements while maintaining the safety of the public, workers, and the environment is essential for a successful project. For those facilities that contain, or will contain, hazardous materials, continuous development and integration of safety analysis as an integral part of design is required. This is accomplished using ISM within design as described in Section 3.1.2. The task of developing the safety basis for the facility often drives design and operational requirements. Integration of safety and design permits timely and cost-effective solutions to be developed early in the project rather than as a crisis backfit at the end of the project. Providing a design that only meets all of the specified safety requirements may not be adequate to implement a safety-through-design approach.

3.1.3.3 Project Authorization

During project design, construction, and startup there are clear, top-tier project hold points based on risk or hazards, for which an authorization to proceed is required. These top-tier project hold points are identified on the project integrated schedule. Safety and environmental documentation support each of these authorization points. The authorization basis for the design phase for facilities with a DOE-STD-1027 categorization of HC-3 or higher must include the PSAR, the SER for the PSAR, and the feedback from independent design reviews. Authorization for facilities below HC-3 is based on an Auditable Safety Analysis (ASA), such as through a Health and Safety Plan (HASP). The results from these elements should be used to develop the basis for authorizing and completing design work. During the construction phase adherence to the approved PSAR (or ASA) and enforcement to the PSAR/SER requirements should be key elements for authorizing construction work. Finally, the authorization basis for the startup activities should be completing the PSAR required items as well as the SAR/SER items needed to satisfy the DOE approved FSAR. Each of these authorizing documents (and the ISM description) need to be updated periodically (typically annually) as a result of mission changes, budget changes, feedback from design reviews, construction/startup issues and to reflect the development of the FSAR which only occurs in the later phases of new facility development. Hold points should also be implemented at a lower “task” level to assure that proper attention has been placed on each of the potentially affected areas prior to these project critical decision points.

3.1.4 Safety Documentation and Project Support

Timely development of safety documentation is critical to project implementation and support of design and construction activities. As described in Section 2, Figure 2-3 depicts the major stages of the project and the documentation needed to support each stage.

A key project element is the alignment of the requirements, the documentation, the facility, and the work practices associated with the facility throughout all project phases.

Critical roles for safety, following the design phase, are construction or remediation safety, testing and turnover activities, and ultimately, safety for the operations phase, which is not covered in this manual.

3.1.4.1 Safety in Technology Development and Demonstration Activities

Any activities associated with tests, experiments, proof-of-principle or technology development related to a project must also be carried out using the guiding principles and core functions of ISM according to DOE P 450.4. These activities must be adequately planned, have hazards analyzed and controls put in place, be performed within controls, and have a review and feedback function.

3.1.4.2 Construction Safety

Construction safety is best implemented using five core functions and principles of DOE P 450.4 and its implementing guide. To assure cost-effective implementation, plans for construction safety need to be developed as part of project planning and documentation. It is critical that during construction, hazards are analyzed and appropriate controls established to protect workers. These controls should be those specified by OSHA, plus any others needed to ensure safety. Safety programs then ensure that construction activities are performed within controls. Finally, review mechanisms verify appropriate implementation of the construction safety program and that the constructed facility meets design/safety requirements.

Preparation and use of installation/assembly procedures is an example of a valuable control. These procedures typically identify the methods of erection, special tooling/rigging, hold points and acceptance criteria. This planning/documentation ensures the task is thoroughly evaluated prior to proceeding. Involvement of all affected functions in the preparation of these procedures minimizes potential issues during construction.

3.1.4.3 Acceptance Testing and Turnover Safety

Acceptance testing and turnover safety is best implemented using five core functions and guiding principles of DOE P 450.4 and its implementing guide. It is critical that during this phase, hazards are identified and evaluated, and proper controls established. Of particular importance, are hazards associated with stored energy (pressure, temperature), electrical, fluid flows, and operating equipment. Of critical importance is controlling ownership of portions of the facility during this phase. Knowing which portions of the facility have been turned over to operations and which portions have not is critical to maintaining safety during turnover. If a phased turnover is planned, special attention needs to those structures, systems, and components that are in operation, and the interfaces with nonimpacting structures, systems, and components.

3.1.4.4 Safety in Facility Disposition Activities

Projects involving Facility Disposition activities should use the guidance in DOE-STD-1120-98, *Integration of Environment, Safety, and Health into Facility Disposition Activities*.

3.2 ENVIRONMENT

The principle for environmental integration is that Project Managers are committed to being stewards of the environment and execute projects in an environmentally sound and responsible manner. The scope of DOE projects often involves the handling, treating, storing, transporting, or disposing of hazardous, toxic, or radioactive material or waste. DOE is committed to complying with all applicable environmental laws and regulations, and for being responsible in preserving and improving the quality of the environment. DOE demonstrates this commitment by integrating environmental safety, including pollution prevention, waste minimization, and resource conservation activities, into all DOE projects. DOE also applies a tailored approach to environmental management to ensure a cost-effective, value-added approach to complying with environmental requirements and concerns. A key principle is that projects conduct all activities in a manner appropriate to the nature, scale, and environmental impacts of these activities, while maintaining compliance with applicable federal and state legislation and regulations. Specific implementation practices and requirements are described 3.2.2.

3.2.1 Background

International Standards Organization (ISO) 14001 principles have been used by DOE sites and projects to implement an environmental management system as required by Executive Order 13148. ISO 14001 defines a framework for the environmental management system associated with most DOE projects. The system is composed of the elements of an organization's overall management structure that address the immediate and longterm impact of its products, services, and processes on the environment.

3.2.2 Environmental Protection and Compliance

Each DOE project shall be implemented under a written environmental management process to anticipate and meet growing environmental perfor-

mance expectations, and to ensure ongoing compliance with national and international regulatory requirements. This management process may either be facility/project specific or a sitewide management system. Environmental management processes are discussed in Executive Order 13148, "Greening the Government Through Leadership in Environmental Management" and DOE G 450.4-1A, "Integrated Safety Management System Guide." **The environmental baseline for the project shall be established prior to any work being performed at the site.** For ER projects, the environmental baseline is typically provided as an integral part of the baseline risk assessment. In addition, environmental baseline monitoring may be required for one year prior to beginning construction.

Implementation of an environmental management system may be through compliance, and certification to ISO 14001, "Environmental Management Systems—Specification with Guidance for Use." In general, if a project is going to implement ISO 14001 or an equivalent environmental management system, the management program should achieve the principles noted below. These principles become specifics within the project overall ISMS.

- Assess potential environmental impacts
- Assess legal and regulatory requirements
- Establish an appropriate life-cycle environmental policy, including a commitment to prevention of pollution
- Determine the legislative requirements and environmental aspects associated with project activities, products, and services
- Develop management and employee commitment to the protection of the environment, with clear assignment of accountability and responsibility
- Encourage environmental planning throughout the project's life cycle for all project activities from planning through closeout
- Establish a disciplined management process for achieving targeted performance levels
- Provide appropriate and sufficient resources, including training, to achieve targeted performance levels on an ongoing basis
- Establish and maintain an emergency preparedness and response program
- Continuously evaluate environmental performance against policy, appropriate objectives and targets, and seek improvement where appropriate

- ▶ Establish and maintain appropriate communications with the customer and internal and external stakeholders
- ▶ Encourage and, as appropriate, require contractors and suppliers to establish an environmental management system or other type of written environmental management process.

Environmental considerations are part of most projects, regardless of the project type (e.g., design, construction, environmental cleanup, or facility startup). The Integrated Project Team needs to understand the regulatory framework for the various environmental regulations—particularly those associated with environmental cleanup. **Therefore the IPT shall include support from an environmental specialist.** The typical steps each project needs to complete to ensure it meets its environmental stewardship commitment are outlined in Figure 3-2.

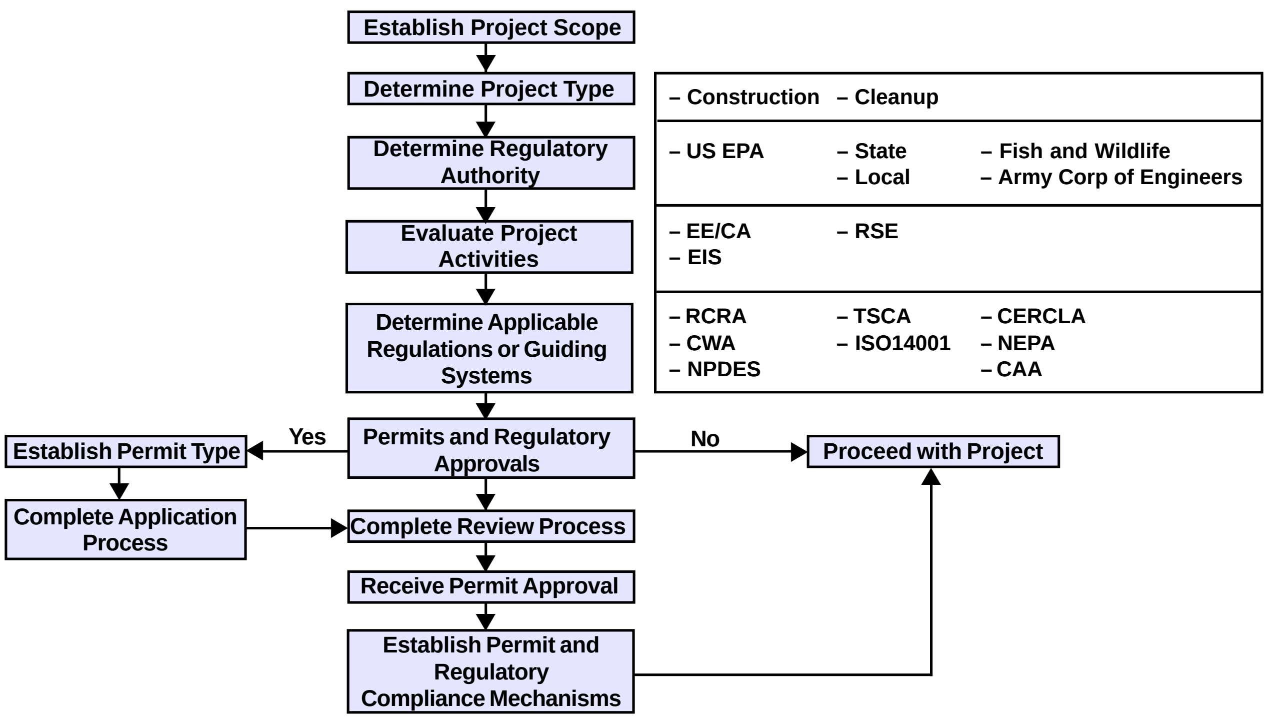


Figure 3-2. Typical Environmental Activities for DOE Projects

An example of one of the environmental regulations that may be applicable to the project is the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). CERCLA is guided by the National Oil and Hazardous Substance Pollution Contingency Plan, commonly referred to as the National Contingency Plan (NCP). **This plan outlines the steps that shall be followed in responding to situations in which hazardous substances, pollutants/contaminants, or oil are inadvertently released into the environment.** The NCP establishes the criteria, methods, and procedures that the U.S. Environmental Protection Agency (EPA) and other federal agencies (including DOE) are required to use to determine priority releases for longterm evaluations and response.

The NCP does not specify project cleanup levels or how a cleanup will be conducted. The NCP relies on other regulations, (e.g., RCRA, Clean Water Act (CWA), and Clean Air Act (CAA)) to provide cleanup levels and the framework for managing a CERCLA project site. Figure 3-3 outlines the CERCLA regulatory hierarchy.

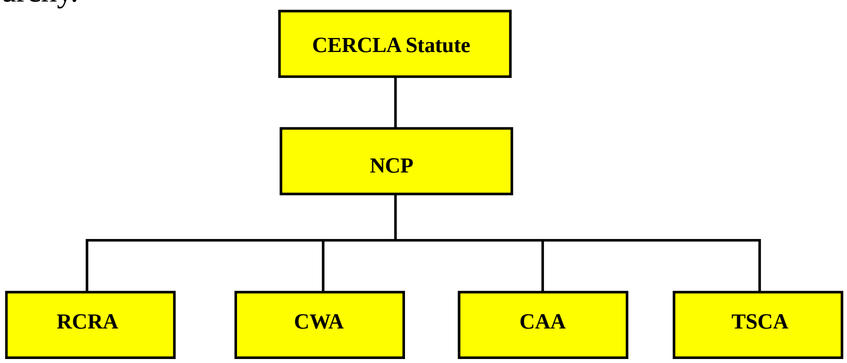


Figure 3-3. CERCLA Regulatory Hierarchy

DOE projects may have additional environmental regulations that projects must be required to meet. The NEPA process is an example of one such regulation. This process is a decision-making and planning tool for any DOE project that could have an environmental impact, not just environmental cleanup projects.

3.3 Quality Assurance

The Project Manager is responsible to plan and implement a Quality Assurance Program for the project and for assuring that along with safety, health, and environmental protection is integrated with the project. The line organizations are responsible for assuring the quality of the project. Quality Assurance (QA) begins at project conception and runs through design, development, construction, fabrication, operation, remediation, and D&D. Quality affects cost, availability, effectiveness, safety, and impact on the environment. Therefore, appropriate aspects of quality assurance need to be given careful consideration during the preparation of project documentation. This is accomplished when there is a recognized need to obtain the level of product and performance quality necessary to accomplish program objectives; provide reliability and continuity of operations, commensurate with Departmental responsibility for health and safety; and for the protection of personnel, the environment, and property.

- The project manager is responsible for defining and assuring effective implementation of required QA activities to be established and implemented by the contractor.
- Line management is responsible for assuring compliance with quality implementing procedures and practices.

QA is mandated through the promulgation of an Order (414.1A) and a Rule (10 CFR 830.120). The Order is for all projects and facilities, and requires that both DOE and its contractors prepare and comply with an approved Quality Assurance Plan (QAP). Title 10 CFR 830.120 identifies the top-level quality assurance requirements for establishing quality assurance programs for DOE management, operating contractors, and organizations performing work at or for DOE nuclear facilities.

The Order and Rule provide the basic areas to be covered by the project Quality Assurance Program. For nuclear projects, 10 CFR 830.120 and its attendant Price Anderson Act Program shall be implemented. For other programs, DOE Order 414.1A shall be applied.

10 CFR 830.120 and DOE O 414.1A have the same basic 10 requirements, subdivided into three sections. Successful implementation of these criteria can be summarized as follows:

A. MANAGEMENT

— Criterion 1 – Program
A written QAP has been be developed, implemented, and maintained.

— Criterion 2 – Personnel Training and Qualification
Personnel have been trained and qualified for the task assigned and training is continuing.

— Criterion 3 – Quality Improvement
Processes are in place to detect and prevent quality problems, control nonconforming items, identify cause and correction of quality issues, and provide for improvement.

— Criterion 4 – Documents and Records
Documents are prepared, reviewed, approved, and issued to specify requirements or establish designs. Records are specified, prepared, reviewed, approved, and maintained.

B. PERFORMANCE

— Criterion 5 – Work Processes

- Work is performed to established standards and controls
- Items are identified and controlled for proper use
- Items are maintained
- Instruments are calibrated and maintained

— Criterion 6 – Design

- Sound engineering standards and principles are being used in the design
- Designs incorporate appropriate requirements and bases
- Design interfaces are identified and controlled
- Design adequacy has been or will be verified or validated by an independent group before the design is implemented

— Criterion 7 – Procurement

- Procured items and services meet established requirements
- Suppliers are evaluated against specified criteria
- Suppliers are routinely evaluated to assure continuing acceptability

— Criterion 8 – Inspection and Acceptance

- Inspection and testing are done to establish acceptance and performance criteria using equipment that has been calibrated and maintained.

C. ASSESSMENT

— Criterion 9 – Management Assessment

- Managers assess their processes

- Problems that hinder achievement of objectives are identified and corrected

— Criterion 10 – Independent Assessment
Independent assessments are planned and conducted to measure item and service quality, measure adequacy of work performed, and promote improvement by groups sufficiently independent of the performers in order to assure the effective performance of these responsibilities. These assessors are technically qualified and knowledgeable in the assessed areas.

3.3.1 Quality Assurance Program (QAP)

The Quality Assurance Program (QAP) describes the overall quality management system and the project responsibility and authority for quality-related activities. The QAP covers the functional activities involved in the production of end items, products, and services.

Senior management demonstrates commitment and leadership to achieve quality through active involvement in the development and implementation of the Quality Assurance Program. Line management is responsible for assuring that line personnel are indoctrinated and trained to the requirements of the QAP Manual and the respective project procedures that implement the quality requirements. Project personnel are responsible for achieving quality in the performance of their work activities.

The QAP identifies line management ownership of quality and provides for line management responsibility and involvement at all levels. It further recognizes the need to continuously assess and improve internal processes.

3.3.2 QAP Requirements

The Integrated Project Team shall prepare a QAP at the earliest possible stage; no later than the beginning of conceptual design. The QAP should address all the applicable elements of either the Rule or the Order. Guidance is provided in DOE G 414.1-2 as to what should be considered in preparing the QAP to meet the Order and would also be appropriate guidance for the Rule. The QAP is a living document, subject to review and revision as the project grows and matures, for example, when a project contractor for the design. The QAP will require revision to address the methods to be used to ensure the design agency is incorporating quality and quality requirements in design activities and deliverables.

The IPT should tailor the selected standards to the requirements of the project to assure an adequate level of control is applied to all project activities. This means that the project activities to be performed should be addressed, explaining the methods used in order to assure the activity is appropriately controlled.

The key requirements to be considered when developing the Project Quality Assurance Program area are included in the references identified in the Practices, Appendix A.

3.3.3 Program Development

Typically, projects select an appropriate industry standard and tailor that standard to meet the applicable requirements of the rule or order and the requirements of the project. For example, a nuclear facility construction project may select ASME NQA-1 as an appropriate industry standard to base the QA program and develop a cross reference matrix between the prepared NQA-1 program and the requirements of 10 CFR 830.120. Tailoring of QA requirements is discussed later in this section. Regardless of the standard selected, a matrix of applicable project procedures to meet the selected industry standard and the rule and order requirements assures that all appropriate control features are in place. An important feature of the program is to carefully separate the project nuclear aspects from the non-nuclear features because of Price Anderson Amendment Act (PAAA) considerations.

The QA program matrix is made of implementing procedures from all aspects of the project. This means that implementing procedures such as procurement procedures, engineering procedures, test procedures, safety procedures, environmental procedures, assessment procedures, and others, as well as the quality assurance procedures are identified in the matrix that makes up the overall Quality Assurance Program for the Project.

The Project QA organization supports the project at all levels, aiding in developing systems and procedures necessary to assure compliance with the applicable project requirements. The QA organization also provides an independent level of assurance, through audits, surveillance, and reviews, that the project, customer, and regulatory requirements are being met. As a responsible member of the project, QA member(s) is responsible to support the project effort to complete the project on time, within budget, and within requirements.

3.3.4 Implementation

Quality program implementation occurs in phases. **As early as possible (but no later than the beginning of conceptual design), the quality standard to be applied shall have been selected and the Quality Assurance Plan (QAP) prepared.** The QAP, includes the quality program matrix identifying how the applicable DOE standards will be met. The QAP and matrix identifies all of the controls required and provides details for implementing the control features, including identification of those controls needing to be in place early. The remaining systems and procedures will be planned and scheduled for implementation prior to need. This means that the procedures for the control of procurement activities will be developed and issued before the procurement activities commence. The design control system procedures will be implemented before commencing design activities are to be controlled. Likewise, construction procedures need to be prepared and implemented prior to starting the construction phase.

3.3.5 Tailoring

A very important task in the development of all formal project processes, including the Project QA program is determining what and how the quality program requirements will be applied. This "tailoring" of requirements is essential to minimizing quality cost by focusing the QA effort on the areas important to successfully meeting the users quality expectations. For example, as soon as the radiologically significant components of the facility are identified, quality program planning should commence to assure that the appropriate quality controls are applied during design, procurement, fabrication, and testing.

An essential component of tailoring the quality requirements is categorizing facility systems and components. Early in the preconceptual stage, the project team should develop a method early in the preconceptual stage to categorize project system, components, and activities based on such things as radiological, environmental, cost, and schedule impact. Where there are existing site categorization systems, the project should seriously consider implementing them rather than creating new systems.

3.4 Source Documents

The DOE orders provide requirements for specific activities, such as packaging and transportation (DOE O 460.1A and 460.2), worker protection (DOE O 440.1A), etc. The specific set of applicable laws and DOE Orders, Standards, Policies, Manuals, and Guides guiding appropriate implementation of safety, health, environmental and quality requirements must be defined for each project. DOE Guides and DOE Standards support implementation of the Orders. The key source documents to be considered when developing and implementing the safety, environmental, and quality portion of the project management activities are listed in the Practices, Appendix B, References. Some of these source documents provide hazard, task, or facility specific requirements.

3.5 Related Early Project Planning Items

For many DOE projects, Safeguards and Security (S&S) is an integral part of project planning and execution. S&S refers to the parameters of physical security that are built into a facility concerning access control, intrusion alarms, construction of vaults, property protection features, Operational Security (OPSEC) and even architectural surety. S&S requirements, when applicable, shall be addressed early in the initial phases of a project and along with safety, quality and environmental protection, integrated throughout all project phases. The IPT should include S&S representation, if appropriate, and it should be confirmed and integrated by the project manager. Life cycle cost analysis and overall system engineering should identify the requirements and costs for S&S during the early project planning.

S&S should be considered and incorporated into all phases of a project, examples from Figure 1-2 and Figure 2-3 would be:

- Preconceptual planning—draft a preliminary vulnerability assessment and initiate OPSEC considerations.
- Conceptual design should include a more detailed conceptual vulnerability assessment.
- S&S standards and requirements are incorporated into the design criteria, specifications and drawings.
- Construction and testing should address and confirm S&S design requirements.

Plans and considerations related to S&S should be included as part of the PEP and may affect other components of the PEP, such as emergency preparedness planning, communications, and procurement planning.

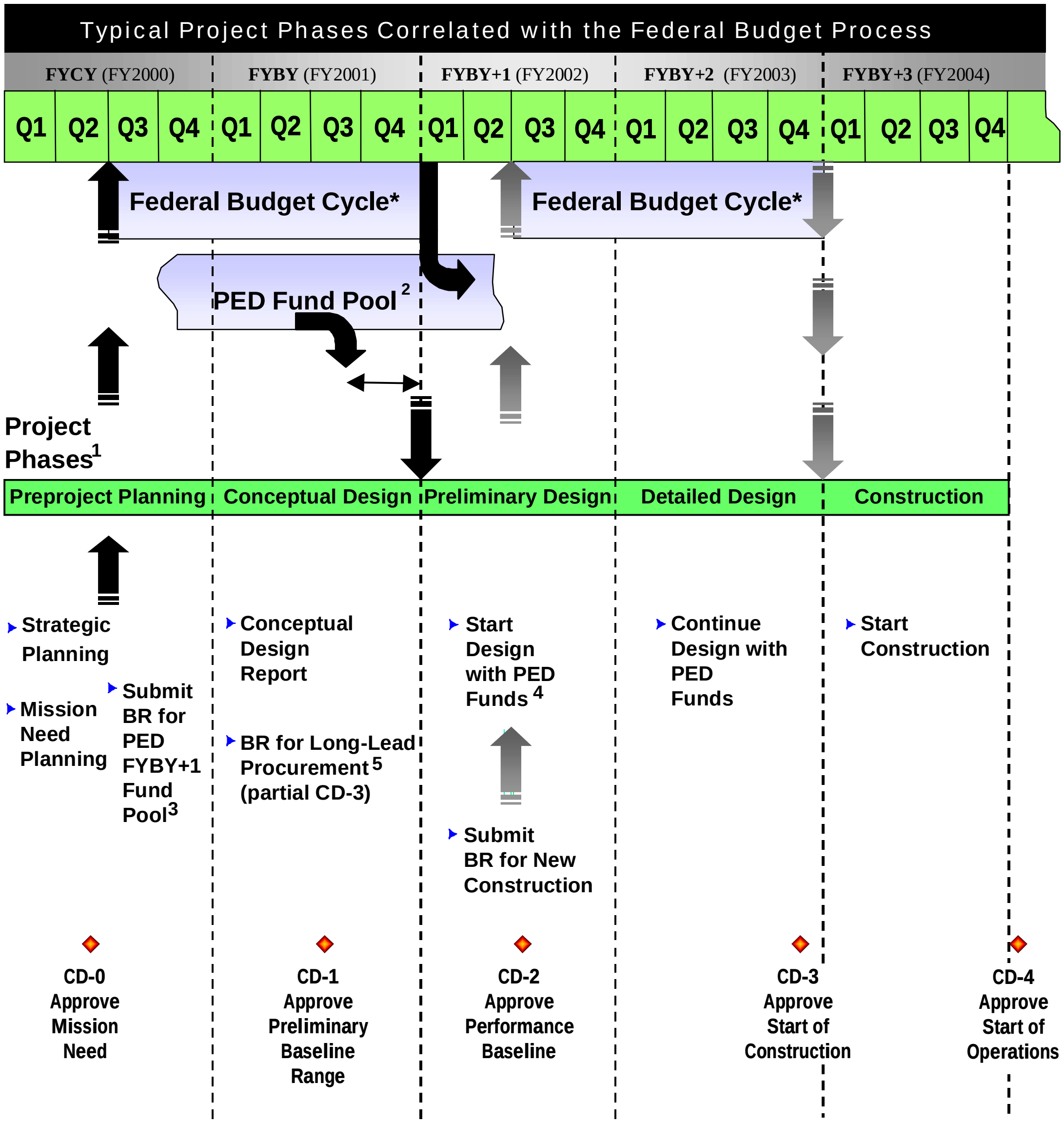
4 PROGRAM/PROJECT DEVELOPMENT, PROGRAMMING AND BUDGETING

The Office of Management and Budget (OMB)/Field budget processes conform to OMB Circular A-11 and the HQ Annual Budget Call. For EM, additional guidance is provided by the Integrated, Planning Accountability, Budgeting System (IPABS). Considerations should be given to other plans and agreements as well as the integrated priority listing. In this manual, a conventional, construction-type project is used as an example.

A summary of the overall DOE budget process is presented in Figure 4-1. Each year the annual cycle repeats itself for the following budget year and begins in December/January (almost 22 months prior to the start of the budgeted FY).

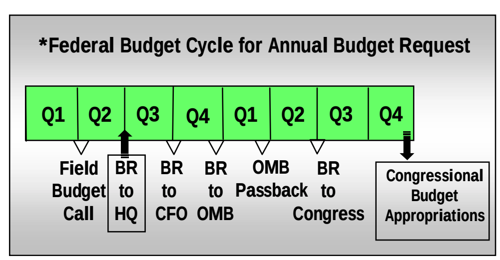
The process begins with the budget formulation stage. This is where funding requirements from all site sources are received, analyzed, and prioritized. This effort culminates in the Field Budget Request submitted to DOE HQ. This includes the new requirements for requesting Project Engineering and Design (PED) funding.

The Field responds to HQ questions as the budget request moves through the HQ Program Offices, the Chief Financial Officer, the OMB, and Congress. (The "HQ Program Guidance" is synonymous with the signed appropriations bill.) While approval can occur by the start of the execution year (current FY), failure results in a Continuing Resolution Bill which can place constraints on certain construction and other activities.



1. The chart is a guide to show how the project phases might typically fit into the annual budget cycle. Actual projects will have different timeframes and should be mapped against the budget cycle accordingly.
2. The PED Fund Pool is a rolling funding source for capital design that Congress appropriates money to each year.
3. PSOs perform strategic planning to build a FYBY+1 Priority Project List. The BR for PED Funds for these projects is based on parametric comparisons and historical project data. In the next fiscal year, the Budget Year becomes the Current Year and the planning process starts again for the new FYBY+1 project.
4. PSOs may authorize PED Funds any time after CD-1 Approval. This provides a window of opportunity to complete preliminary design earlier so the BR for new construction can be submitted in time for the next fiscal budget cycle.
5. If Long-Lead Procurement (LLP) is required, a BR for LLP funding should be approved as a partial CD-3 during the conceptual design phase and submitted into the budget cycle to ensure timely receipt of LLP funds.

Key:
PED - Project and Engineering Design
BR - Budget Request
CD - Critical Decision



4-1. Typical Project Phases Correlated with the Budget Process

4.1 CONVENTIONAL PROJECTS

As described in Section 1, Purpose and Overview, a need or opportunity is identified and a concept is developed into a mission need. Approval of the Mission Need (CD-0) allows a proposed project to proceed to the next step in the planning phase. There is no specific funding/budget for this preconceptual activity; any realized costs are normally absorbed by the identifying organization. However, with the mission approved, a programmatic sponsor undertakes the program/project and it moves from the preconceptual phase to the Conceptual Design phase. Funding then comes from the programmatic operating/expense (OPEX) source. While OPEX may be included in the program budget, it is usually not explicitly identified.

As illustrated in Figure 4-2, these activities can take place almost anytime during the planning years. The goal is to complete the Conceptual Design, and all cost and schedule budget ranges in time to meet the milestone "Field Budget submission to HQ." Properly timed, the funding is coordinated with project development in order to support the most cost-effective execution of the project.

To meet this milestone, a formalized set of requirements exists for work that receives capital funding. These requirements are also generally required for Operating expense-funded construction. The Project Data Sheet (PDS) is the formal request document that accompanies (1) the Field's annual submission to HQ and (2) the Department's annual budget request to OMB and Congress. Contracted work is not initiated until funds have been confirmed to the respective program/project office through the planning programming, budgeting, and acquisition process. Because all capital funded projects include both operating and capital funded activities (other project costs), the PDS requests and reflects both types of funds (1) capital (TEC) and (2) operating (OPC). The sum of these funds is the Total Project Cost (TPC). Use of each of these funds on a project is limited and controlled, and separately reported. That is, each type of fund is identified for specific project activities and cannot be commingled (see Practices, Glossary). In the case of operating funded projects, TEC and OPC may be from the same funding source.

The process is further refined and prioritized through the preparation of the multi-year work plan. This document contains project-level estimated scope, schedule, cost, and performance measures for the entire life of the project. These estimations are updated annually to support the planning and budgeting process, and they reflect past performance plus any changes in expected funding requirements

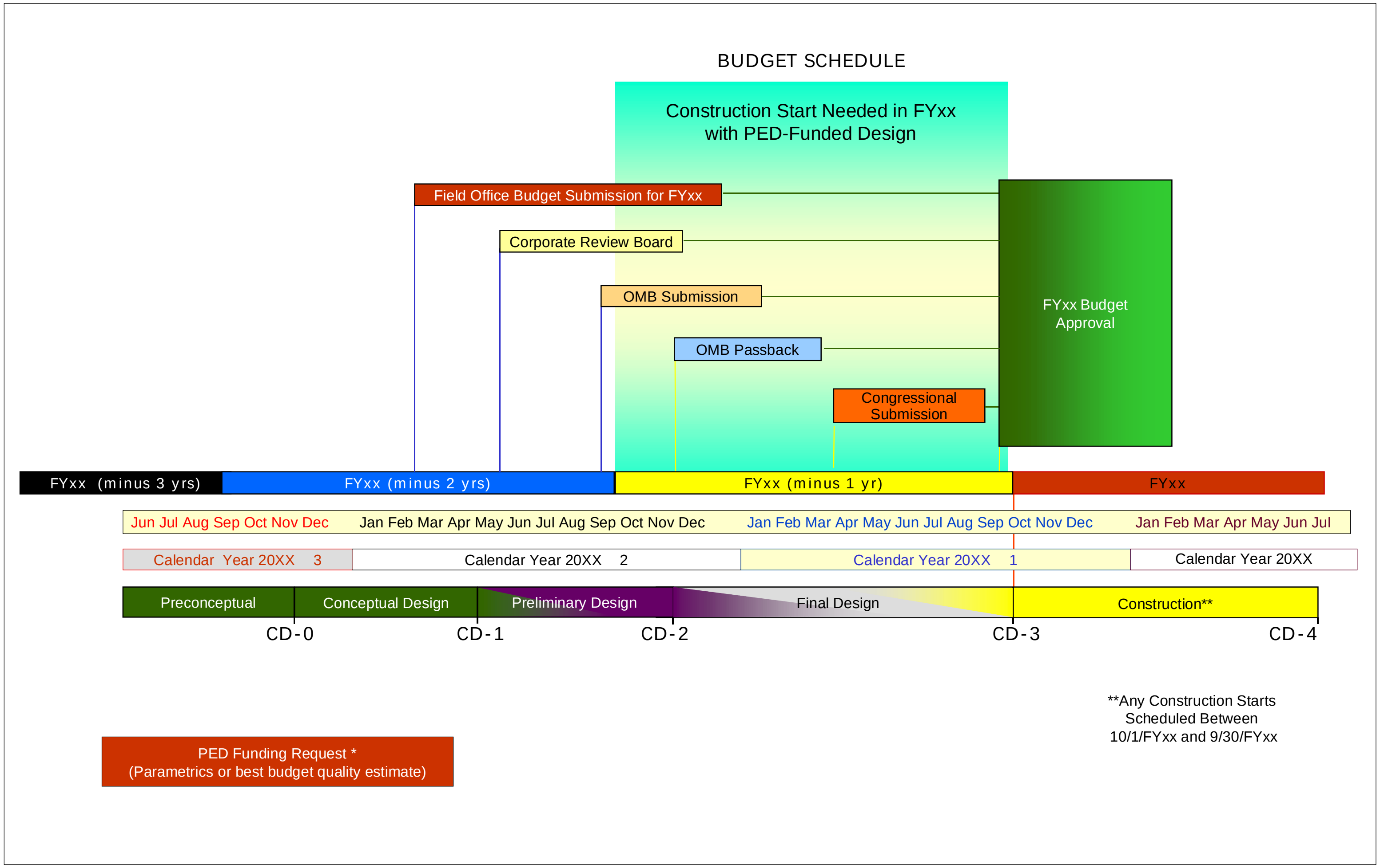


Figure 4-2. Generic Planning, Budget, and Execution Cycle

and/or priorities. The project proposal is then incorporated into a total-site integrated priority listing. This listing, which includes environmental and program mission budget requirements, becomes the Field budget submission. The priority listing is developed using graded criteria that includes such factors as mission need, regulatory requirements, public and worker safety, national importance, cost mitigation, and so forth. Each site develops its own listing, which is integrated into a departmental list as part of the Corporate Budget Review process. This is an iterative process and is performed for each budget year for which funding is requested. (Note that the request for budget is prepared and submitted about 18 months prior [FY-2 or two years before the start of the fiscal year in which project execution is to begin] to the actual Budget Year [FY-1].)

As appropriation bills are signed and the budget is passed on to the Field in the form of a Budget Guidance for program/project execution—design, construct, fabricate, test, and turnover. Since only the first FY of the project's total proposed effort is funded, dollar resources are limited. **Contracting and other procurements shall consider the available funds to avoid liability**.

With the completion of a physical facility and turnover to the user, funding shifts back to operating dollars for all future plant activity, including maintenance. However, upgrades to a facility may be funded as a General Plant Project (GPP), which is capital money under $5M. While limited in availability and restricted in use, its authorization process is not so rigorous.

4.1.1 Project Engineering and Design

A new process to provide capital funding for design has recently been adopted within the Department. The Field may now separate Preliminary/Final design cost estimates on the Project Data Sheet (PDS). HQ Program Offices will extract design costs from the PDS, as appropriate, for funding from a separate Project Engineering and Design (PED) capital-funded design pool.

Potential benefits from this approach are expected to be improved scope definition and cost estimates, reduced cost overruns and schedule slips, and improved project performance. Also, since this is a separate funding commitment, it adds an additional control point for managing construction projects. Design-related tasks may be conducted with PED or operating funds as determined by the program offices. Details of this funding alternative are included in the appropriate Fiscal Year (FY) budget call.

4.2 ENVIRONMENTAL MANAGEMENT PROJECTS

The need for environmental remediation work comes from a totally different perspective than conventional projects. First the work is driven by formal decisions through the NEPA, the CERCLA, and the RCRA Acts process, and also may be a function of a Tri-Party Agreement. As a result, DOE is legally bound to fund and execute the projects in accordance with these agreements.

Second, little funding for EM projects is from capital accounts. EM projects are almost entirely funded from operating/expense sources for their entire life, from preconceptual planning to final remediation.

Finally, individual EM projects are usually part of a larger project at the Field level. Because of the large number of projects, limited funding, and regulatory requirements, it is important that a formal process be followed with all interested parties to determine which projects will be funded each year and to what level.

The timing and budgeting process for EM projects are the same as conventional projects. However, as with any program/project, there are variations in the kind and level of detail required to support a project. EM projects generally require more supporting detail than conventional projects. This is partly because of the prioritization effort that takes place at the Field Office and the total EM HQ level. However, the quantitative ranking process briefly mentioned for conventional construction is also followed for EM work. Another significant difference between the two general types of effort in the budgeting process is that “input” is also received from the regulators, Tribal Nations, and the public before the Budget Request is submitted to HQ.

4.2.1 Environmental Remediation and Facility Disposition Projects

The planning, programming, and budgeting process for ER and facility disposition projects are the same. It is an integrated process that prioritizes all the projects to a common set of criteria. The cornerstone of this prioritization and planning process is the project baseline or multi-year work plan that contains detailed project-level estimated scope, schedule, cost, and performance measures for the entire life of the project. The plans are updated annually to support the planning and budgeting process, and reflect past performance plus any changes in expected funding requirements and/or priorities.

5 PROGRAMS/PROJECTS ORGANIZATIONAL ROLES AND RESPONSIBILITIES

Following are brief descriptions of the roles and responsibilities for line management at the various management levels within the DOE, from the Deputy Secretary through the PSO to the Field Office, and from the Federal Project Manager to the Contractor Project Manager. The most successful method (and the recommended approach) of managing a project is a teaming arrangement, between the entities and the contractor. Teaming develops a shared concern for the work to be performed and is more conducive to problem identification and resolution. However, a key activity to help assure a successful team is a clear understanding of roles, responsibilities, authorities, and accountabilities.

5.1 ORGANIZATIONAL ROLES

Within the DOE, authority begins with the Deputy Secretary of Energy, as SAE, who is the senior manager responsible and accountable for all project acquisitions, may delegate AE authority for Other Projects to the PSOs, with the concurrence of the Under Secretary (for Energy, Science and Environment); or for the NNSA, to the Administrator, NNSA who may redelegate AE authority at his discretion. The organizational and functional relationships between the various offices is reflected in Figure 5-1 and described in the following text:

5.1.1 Deputy Secretary

The Secretarial Acquisition Executive (SAE) reports, as Deputy Secretary, directly to the Secretary and has line accountability for field office and all program/project execution. Additionally, the SAE serves as the Chief Operating Officer (COO) for DOE. The SAE also

- serves as senior manager responsible and accountable for all project acquisitions.
- exercises decision-making authority, including Critical Decisions and Level 0 baseline changes for Major System Projects.
- maintains oversight for projects designated for the COO Watch List.

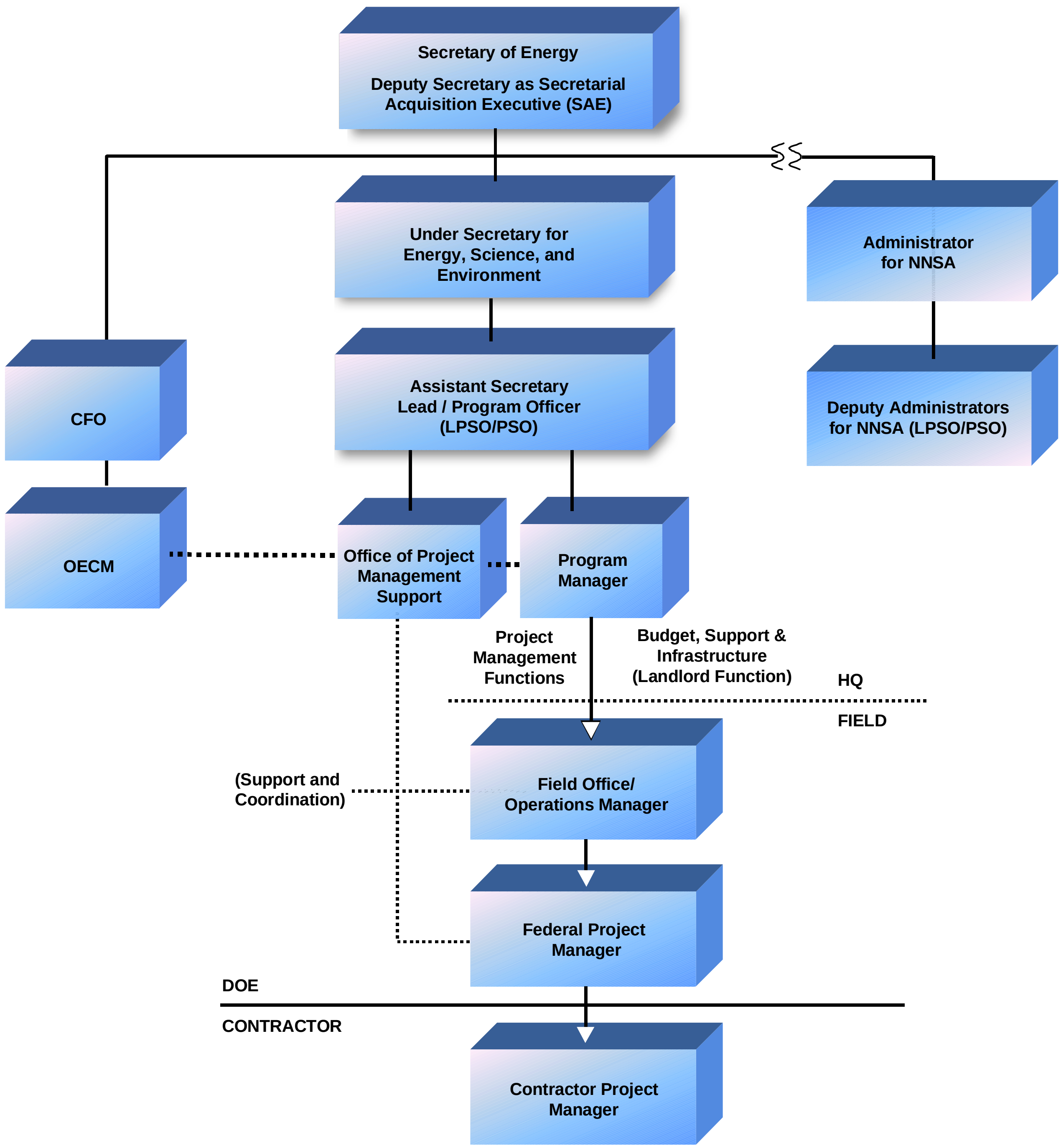


Figure 5-1. Organizational Relationships for Execution

- serves as the Chair for the ESAAB, and directs external independent reviews.
- approves site selection for facilities for new sites.

5.1.2 Under Secretary for Energy, Science and Environment and Deputy Administrator for NNSA

Under Secretary for Energy, Science and Environment consults with SAE and concurs on PSO delegations under its cognizance.

Deputy Administrator for NNSA receives AE authority from the SAE and may delegate AE authority as provided for in the order.

5.1.3 Lead Program Secretarial Office (LPSO), including the Deputy Administrators for NNSA

The LPSOs have line accountability for applicable program/project execution and implementation of policy promulgated by Headquarters staff and support functions.

If LPSOs have project delivery responsibility, they shall establish project management support offices that report directly to them, to provide project management support, throughout their organization.

5.1.4 Program Secretarial Office (PSO), including the Deputy Administrators for NNSA, and Program Directors

This office and/or the staff involved perform the following:

- handle overall line accountability for sitewide environment, safety, and health; safeguards and security.
- responsibility for the success of all MS projects and Other Projects within their programmatic area of control, as the responsible and accountable officer
- serve as Acquisition Executive (AE) for Other Projects that are not designated as MS projects. Approve the CDs and Level 1 baseline changes for those projects
- approve selection of the Federal project manager for projects where the equivalent AE functions have not been further delegated

- define the roles and responsibilities of the project management support office
- delegate, if desired, equivalent AE functions to a Senior Executive Service (SES) program manager or Operations/Field Office Manager for projects with a TPC less than $100M. The recipient of this AE delegation may recommend the duration of a project to a higher level AE at any time.

5.1.5 Program Manager

A program manager

- directs project planning and execution roles for projects assigned by the PSO/ AE.
- initiates definition of mission need, based on input from sites, labs, and program.
- oversees development of project definition, scope, and budget to support mission need.
- initiates development of the Acquisition Strategy and the Acquisition Plan (during the period of time preceding designation of the Federal Project Manager).
- recommends a Federal Project Manager for those projects for which the PSO retains AE responsibility, and approves the Federal Project Managers where the Program Manager has been delegated AE authority.
- develops performance measures, and monitors and evaluates performance throughout the life of a project.
- allocates resources throughout the program.
- oversees and manages the project line management organization.
- performs functions as AE when so delegated by PSO.

5.1.6 Project Manager Support Office

The Project Manager Support Office

- provides independent oversight and reports directly to the PSO.
- serves as the Secretariat for PSO ESAAB-equivalent functions.

- coordinates quarterly performance reports for the PSO.
- coordinates with the Office of Engineering and Construction Management (OECM) to ensure effective and consistent implementation of this Order.
- provides assistance and oversight to line project management organizations
- analyzes the full range of project management and project delivery issues for the PSO.

5.1.7 Operations/Field Office Manager

The office/staff involved

- reports directly to an LPSO and has line accountability for contract management of all site program/project execution.
- recommends a Federal Project Manager for those projects for which the PSO retains AE responsibility; approves the Federal Project Manager where the Operations/Field Office Manager has been delegated AE authority.
- for projects with TPCs less than $20M, may delegate project planning and execution roles, including performance reviews, to a direct reporting subordinate manager (or SES subordinate manager for AE delegation).
- performs functions as AE when so delegated by PSO.

5.1.8 Federal Project Manager

A Federal Project Manager is

- responsible and accountable for project management activities of one or more discrete projects under his or her cognizance. General plant projects, accelerator improvement projects, capital equipment projects, and operating expense funded projects that are $5M or less are the responsibility of the Federal Project Manager as delegated by the Operations/Field Office Manager.
- responsible and accountable for planning, implementing, and completing a project using a systems approach.
- develops and implements the Acquisition Plan and Project Execution Plan.
- defines project objectives, scope, schedule, and cost.

- allocates project funding and authorizes work activities.
- oversees the design, construction, environmental, safety, and health efforts performed by various contractors, and other functions enumerated in the Project Execution Plan, in accordance with public law, regulations, and Executive orders.
- serves as the single point of contact between Federal and contractor staff for all matters relating to the project and its execution.
- serves as the Contracting Officer's Technical Representative, as appointed.

5.1.9 Contractor Project Manager

A Contractor Project Manager

- manages day-to-day execution of assigned projects in a cost-effective manner, in accordance with requirements, procedures, and standards, as set forth in the contract. (See CRD, O 413.X, Attachment 1.)
- executes projects within approved cost, schedule, and scope baselines, as defined in the Project Execution Plan, as set forth in the contract.

5.1.10 Office of the Chief Information Officer

The Office of the Chief Information Officer

- establishes and maintains Department-wide guidance for Information Technology (IT) investment management processes, including IT (e.g., hardware, software, and application) and capital assets.
- designs and guides implementation of the corporate-level IT investment management process.
- provides IT investment management process assistance to Program Office, Field Office, site, and contractor locations, as requested.
- collects process performance measurement information regularly and prepares a summary report on the status and performance of IT investment management processes.

5.1.11 Office of Engineering and Construction Management
(within the Office of the Chief Financial Officer)

The Office of Engineering and Construction management

- serves as DOE's principal point of contact relating to project management.
- develops policy and assists in the planning, programming, budgeting, and execution process for the acquisition of capital assets in coordination with PSOs and project management support offices.
- supports the Office of the Secretary, the Chief Operating Officer, the Administrator of NNSA, and Program Secretarial Offices in the CD process for MS projects and oversight of DOE's project management process.
- serves as Secretariat for the ESAAB and Chief Operating Officer Watch List functions.
- establishes and oversees the Federal Project Manager career/professional development programs.

5.1.12 Integrated Project Team

The Integrated Project Team (IPT) performs as a program/project team in either an informal or formal relationship. **The team leader shall be the Federal project manager.** He must be experienced in project management and, if possible, the particular technology being developed/implemented.

The IPT is the support team having the responsibility for project planning, development, design/engineering, and construction/remediation as director by the Federal project manager. The project manager should understand the user needs and constraints, and have the demonstrated ability to manage large projects to scope, schedule, cost, and performance goals, and effectively lead the IPT. Team support personnel should be cross-functional and provide experience in project control, procurement, finance/budgeting, contracting, and user technology requirements, as appropriate and necessary. As a project progresses from preconceptual to completion, the IPT will change in both members and capabilities. This flexibility allows the project manager to adapt the IPT to meet the constantly changing project needs. The IPT supports the project from preconceptual to closure in order to facilitate management and accountability.

As appropriate, the contractor should provide IPT support with similar cross-functional personnel and leadership. The level of commitment of IPT members may be less than full-time, if the project is not of sufficient size or complexity to warrant full-time. **However, IPT support shall be each member's first priority.** Working together, the IPT needs to focus objectively on the project's mission as its primary responsibility. The IPT formulation and charter should be documented in the PEP. See Section 7.2.1.

5.2 Energy Systems Acquisition Advisory Board

The Energy Systems Acquisition Advisory Board (ESAAB) advises the SAE in making MS project CDs, Level 0 baseline changes, and site selections for facilities for new sites. The ESAAB meets once every 2 months, or at the call of the SAE.

Membership. ESAAB membership includes the SAE as Chair, the Under Secretaries, General Counsel, the Chief Financial Officer, the Director of OECM, the Assistant Secretary for Environment, Safety and Health, the Assistant Secretary for Environmental Management, the Deputy Administrator for Defense Programs, the Director for Office of Science, and the Director of Procurement and Assistance Management. The Deputy Secretary may designate other PSOs or functional staff as board members as needed.

ESAAB Secretariat. The ESAAB Secretariat resides in OECM and provides administrative and analytical support and recommendations to the ESAAB.

5.2.1 Other Project ESAABs

Each appropriate PSO appoints an ESAAB-equivalent board for advising on actions regarding those projects within the PSO office that are not MS projects. The PSO serves as AE for these projects and as chair of the ESAAB-equivalent board. The ESAAB-equivalent board replicates and conducts the same functions as those performed by the corporate ESAAB. Members may be selected from within the PSO's office or from other Headquarters functions having Departmental responsibility. At least one member is from a different PSO office and is designated by the contributing PSO. OECM provides a member of each ESAAB-equivalent board for projects having a TPC of $100M and greater. Each PSO provides the composition of its ESAAB-equivalent board to OECM.

5.2.2 Delegated Other Project ESAABs

The Program Secretarial Office (PSO) may delegate equivalent AE functions, including decision approvals, for those Other Projects below $100M to a SES program manager or an operations/field office manager. For those delegated Other Projects below $20M, the Program Manager or O/FOM may further delegate equivalent AE functions to a direct reporting SES subordinate. DOE O 413.X, Attachment 3 provides an overview of the allowable AE delegations. The AE so designated establishes and chairs an ESAAB-equivalent board, notifies OECM of its composition, invites OECM to all board meetings, and provides all agendas and minutes to OECM and the appropriate PSO project management support office. However, OECM is not a board member.

5.3 DELEGATIONS

The Program Secretarial Office (PSO) or Deputy Administrator for NNSA may delegate equivalent AE functions, including decision approvals, for projects with a total project cost of less than $100M to a Senior Executive Service (SES) program manager or Operations/ Field Office Manager (O/FOM). For those delegated Other Projects below $20M, operation/field office manager may delegate equivalent AE functions to a Senior Executive Service direct reporting subordinate of the Operations/Field Office Manager. Figure 5-2 provides an overview of the allowable AE delegations. The AE so designated establishes and chairs an ESAAB-equivalent board.

Project Type	Critical Decision Authority	Typical Project Requirements		Acquisition Executive Delegation Allowed
Major System Projects	Secretarial Acquisition Executive	**$400M**	Quarterly review by PSO Performance Baseline External Independent Review (EIR) Execution Readiness EIR Energy System Acquisition Advisory Board Earned Value Management System reporting required	
Other Projects	Program Secretarial Officer (Acquisition Officer) or Deputy Administrator for NNSA	**$100M**	Quarterly review by PSO Performance Baseline EIR Execution Readiness Independent Project Review Energy System Acquisition Advisory Board - equivalent Earned Value Management System reporting required	
		$20M	Quarterly review by Program Secretarial Officer or delegate Performance Baseline EIR Execution Readiness Independent Project Review Energy System Acquisition Advisory Board - equivalent Earned Value Management System reporting required	To a Senior Executive Service program manager or operations/ field office manager
		$5M	Quarterly review by Program Secretarial Officer or delegate Performance Baseline EIR Execution Readiness Independent Project Review Energy System Acquisition Advisory Board - equivalent Earned Value Management System reporting NOT required	To a Senior Executive Service direct reporting subordinate of the operations/ field office manager

Figure 5-2. Decision Authority Thresholds

6 DECISION POINTS AND AUTHORIZATION

Critical Decisions (CD) are hold-points in the life cycle of a project. The Critical Decisions provide DOE management and contractors an opportunity (1) to examine the work, particularly in terms of continuing need, and (2) to determine if previously validated technical concepts and attendant cost and schedule parameters remain appropriate. At each CD, a review or analysis of a project is conducted and a decision is made to either continue or expend resources to move the program/project acquisition into a subsequent phase, or discontinue the project. An independent review or baseline validation of the project may be conducted prior to each request for a CD and will vary in scope dependent on the phase of the project, current condition, or cost/complexity.

Responsibility for CDs rest with the SAE for MS projects. For non-MS projects, CD responsibility is assigned to the next lower management tier consistent with the project's estimated value and delegations. A CD is not intended to be a hinderance on the path to project completion; it is an opportunity to examine all aspects of the project. Thus, CDs ensure that a project is still valid in light of changing missions, technologies, and other influences such as negotiated agreements. Too often, DOE projects have continued to be developed and pursued based on momentum rather than informed decisions.

6.1 CRITICAL DECISIONS FOR CONVENTIONAL PROJECTS

A CD process facilitates oversight of conventional projects. EM, environmental remediation and disposition projects have enough difference from conventional projects that they are discussed separately. Detailed instructions for CD support documentation are provided in Practice 14, Critical Decision Packages. The relationship of CDs to the project life cycle is shown in Figure 1-1. The conventional project Critical Decisions flow is as follows:

- ***CD-0, Approve Mission Need***

  Program funds needed to develop the proposed project's conceptual design shall be approved and a limited review accomplished that validates the mission need and funding request. Based on the very preliminary information that is available prior to approving funding the Department will determine that there is a legitimate tradeoff in scope, cost, and schedule. Approval of CD-0 confirms mission need and allows the expenditure of program funds to develop the Conceptual Design.

- ***CD-1, Approve Preliminary Baseline Range***

One output of the conceptual design effort is the Conceptual Design Report (CDR). The CDR documents the baseline range (preliminary scope, schedule, and cost estimates for the project). Conceptual design documents and supporting plans and reports provide the basis for the decision to begin preliminary design. Changes to the preliminary baseline range for the project are documented and controlled through the change control process. CD-1 also provides approval to expend PED funds for design.

- ***CD-2, Approve Performance Baseline***

At the end of preliminary design (approximately 20 to 35 percent of the total design process), the performance baseline for the project is established and, in effect, is "cast in concrete." Critical Decision-2 is of paramount importance to the project since it initiates a request for construction funds which involves Congress. A request for CD-2 also exposes the project to external reviews, including an ICE. An external review of the project also serves as a measure of a Department's overall performance to date. Documentation prerequisites for CD-2 are identified in the PEP. A major input for CD-2 approval Independent Cost Estimate (ICE) and an integrated or separate performance baseline External Independent Review (EIR), validation review. CD-2 decision is also commensurate with the Department's commitment to continue with final design and establish a baseline budget for construction.

- ***CD-3, Approve Start of Construction***

With design essentially complete and all environmental and safety documentation in place, the project initiates construction (including procurement) activities. CD-3 approves the expenditure of funds for construction activities. The decision to proceed with construction is well documented and reviewed by either an Execution Readiness EIR, for MS projects, or an IPR for other projects. The type of review depends upon the project's TPC. As with other project decisions, there is no substitute for careful, thorough reviews and an informed decision. Construction is generally performed with capital funds—funding type, however, is not a driver for CD-3.

To this point, each Critical Decision occurs at a discreet point in time. For particular decisions, however, it may be necessary to subdivide CD-3. For example, a long-lead procurement might constrain construction, and an early or phased CD-3 could be initiated and justified. In this case, however, the decision is only applicable for this particular procurement package. While there is potential risk in procuring equipment before the design is complete, the potential schedule improvement may be significant and more than compensate for the risk. If an early or phased CD-3 is anticipated, the need for this decision and the process should be detailed in the PEP as the need is identified.

- ***CD-4, Approve Start of Operations or Project Closeout***

  The prerequisites for CD-4 include: construction complete (including the punch list), final safety documentation completed and issued, Operational Readiness Reviews (ORR) successfully conducted, and the facility turned over to the user for beneficial occupancy. The project is ready to begin operation, if that was the intended scope, and permission to proceed is granted by CD-4. At this time, the use of construction funds to support the project ceases.

6.2 CDs for Environmental Management Projects

An environmental Management projects, as defined in the EM Integrated Planning Accountability System Handbook, do not readily fit organized phases as well as conventional projects. Therefore, these projects do not always lend themselves to the same decision process. However, in order to ensure a systematic review and decision process, EM divides these projects into the following types:

- EM Conventional Projects
- Environmental Restoration (ER) Projects
- Facility Disposition Projects (Deactivation and Decommissioning).

6.2.1 EM Conventional Projects

EM work that may be categorized as conventional shall be projectized and managed as a separate project. The acquisition process is the same as a conventional project, except there are often more regulatory drivers that initiate the project activity.

6.2.2 Environmental Restoration (ER) Projects

While CDs for ER work are appropriate, they do not introduce phases that are consistent with conventional projects; rather the CDs require decisions that fit the regulatory and remediation process. ER work requiring lower-tier work that may be classified as conventional should be projectized and managed as a separate project.

ER projects are based on RCRA, CERCLA, or other regulatory commitments. These regulations and agreements, together with regulatory direction, provide the input for the decision to proceed into the ER equivalent of mission need (CD-0). The CD process as it relates to ER acquisition phases is presented in Section 2, Figure 2-3. CDs for ER projects are as follows:

- ***CD-0, Approve Mission Need***

  Approval of the mission need enables the work to proceed into the investigation and characterization process. A Remedial Investigation/Feasibility Study (RI/FS) is developed and analytical sampling, geophysical investigations, modeling, and proof-of-principle testing are performed. Studies conducted during this phase serve to establish the technologies or processes necessary to remediate the particular site. This phase supports the selection of a remedial alternative and project specific remedial goals, and the establishment of project technical requirements and design criteria. Issuance of a PA/SI report, Site Assessment Report, or Removal Action Report or equivalent will be the basis for completing CD-0.

- ***CD-1, Approve Preliminary Baseline Range***

  Approval of the preliminary baseline range includes the completion of the Proposed Plan, Statement of Basis, or equivalent (e.g., RCRA permit modification). In addition to US DOE review, the US EPA, state, other stakeholders, and Tribal Nations (as appropriate) review the Proposed Plan or Statement of Basis. Approval of CD-1 allows the commencement of final design activities including studies, specification/drawing preparation, other regulatory permits, etc. Any long-lead procurement actions are also initiated at this time. The Proposed Plan/Statement of Basis and an updated schedule and estimate will be the basis for CD-1 and establishment of cost and schedule baseline ranges.

- ***CD-2/3, Approve the Start of Construction/Remedial Action***

  CDs-2/3 are finalized upon completion of engineering and design sufficient to allow the start of construction/remediation. With engineering completed, all required environmental and safety documentation is in place and third-party concurrences have been obtained; therefore, physical cleanup activity is ready to proceed. Often the design is defined in specifications. This activity nominally equates to the construction phase of a conventional project. Updated cost and schedule baselines form the basis for approval of CD-2/3.

- ***CD-4, Approve Start of Stewardship or Remediation Complete***

  Upon approval of CD-4, operations and/or maintenance may begin (if that is included in the project scope), or the project is closed. The completion or closeout of a project consists of completion of all post-construction documentation required for the restoration activity and transfer of the site for alternative use or longterm stewardship as prescribed by the ROD, permit, or Post-Closure Plan.

6.2.3 Facility Disposition Projects

For decommissioning and transition work, project phases align more with conventional projects. The CD process, as it related to disposition acquisition phases, is presented in Section 2, Figure 2-2. Critical Decisions for disposition projects flow as follows:

- ***CD-0, Approve Mission Need***

  CD-0 is appropriate and consistent with conventional projects, except that planning/feasibility cost estimates are focused more on tradeoffs involving demolition verses stabilization and longterm oversight. Proof-of-principal testing is identified and performed during this period.

- ***CD-1/CD-2, Approve Performance Baseline***

  The CD-1 and CD-2 are a combined decision. This combined baseline approval is identified as CD-1. The existing conceptual information is folded into the submission for baseline approval at the approximately 30 to 35 percent of completion design. This is done with the understanding that a design is not conventional since it identifies activities that may demolish or stabilize (entomb) a structure, rather than performing conventional construction. The effort then enters into the detail or final design activity.

- ***CD-3, Approve Start of Construction or Remedial Action***

  The design is complete; all required environmental and safety documentation is in place; third-party concurrence has been obtained; and physical activity is ready to proceed. Often, however, the completed design is more in the form of specifications that can be used to obtain bids. This activity (1) equals the construction phase of a conventional project and (2) starts transition, deactivation, decontamination, and decommissioning. Therefore, the decision to proceed to this portion of the execution phase is well documented and reviewed.

- ***CD-4, Approve Start of Operations or Project Closeout***

  For decommissioning activities, CD-4 indicates that (1) all work is performed and (2) the project is complete, or the site is ready to be turned over for alternative-uses, longterm stewardship or surveillance. Also, all environmental documentation is complete.

7 PROJECT PLANNING, INTEGRATION, AND REVIEWS

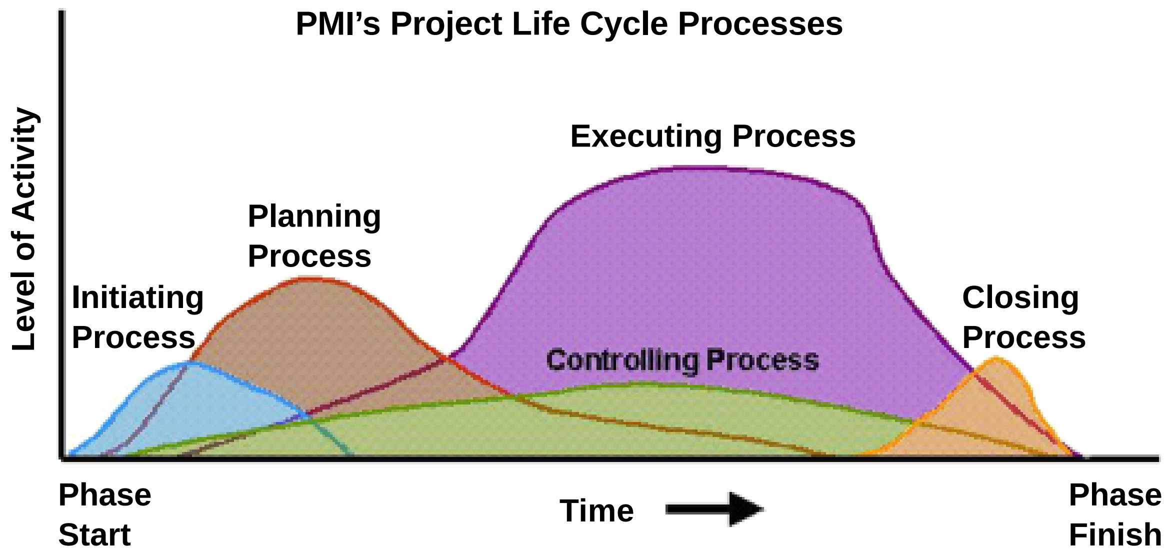


Figure 7-1. Overlap of Process Groups in a Phase

Figure 7-1, as represented by the Project Management Institute (PMI) illustration of process group overlap, shows projects processes overlap and vary as a project progresses over time. A tailored approach should be implemented to determine the formality and rigor to be applied to the project processes. Factors such as the project's importance to safety, worker, public health, environmental/regulatory compliance, current level of knowledge, safeguards and security, programmatic importance, magnitude of hazards involved, financial impact, and schedule constraints should be considered.

The approval of CD-0 is the formal initiation of a project. The approval recognizes that a new project exists and should continue to the next phase. Project planning, integration, and reviews involve detailed iterative processes that organize and validate work that accomplishes the mission by an optimally approved method.

7.1 PROJECT PLANNING

Planning (1) ensures that essential elements are included in the implementation of the project and (2) establishes the appropriate rigor and formality of documentation. Planning should address two objectives:

- Perform conceptual phase activities which include preparing a Project Execution Plan (PEP) and obtaining CD-1
- Perform further engineering to better define the scope, schedule, and total project cost in an Approved Performance Baseline (CD-2).

The project manager establishes the content for the initial project-planning documentation and uses a tailored approach to match the project size, complexity, and risks to the planning elements. Planning should provide for the following activities:

- Determine and describe the organizations performing the conceptual and preliminary design activities. Organizational descriptions should include staffing levels and personnel qualifications.
- Develop technical objectives and stakeholder values that will form part of the basis-for-decision criteria to select from alternative solutions.
- Identify and pursue needed process/technology research and development.
- Develop a listing of imposed external constraints, such as Federal and state laws and regulations, departmental directives, and program policies.
- Develop operational and closeout scenarios, including cost estimates to be used in the life-cycle cost analysis.
- Identify and analyze requirements and functions for the project deliverables.
- Assess specific risks to evaluate the impacts on functions, requirements, schedule, cost and resources.
- Prepare a project schedule including major milestones, activity start and completion dates, time-phased resource needs, and critical path.
- Prepare cost estimates, including total estimated cost and related other project costs that together represent total project cost.
- Identify annual funding requirements and life-cycle cost estimates.

- Evaluate environmental impacts including pollution prevention, waste management issues, and a determination on NEPA documentation.
- Prepare a preliminary safety/hazard assessment report.
- Prepare an initial Work Breakdown Structure (WBS) and WBS dictionary. The WBS should align with the main subsystem and major elements of the deliverables.
- Provide schedule and event-driven reporting to satisfy a project's monitoring, control, and oversight needs during the conceptual and preliminary design phases. Planning should also provide for in-house reviews and independent reviews to confirm self-assessments of work progress.
- Provide for evaluations of various project performance reports, identification and assessment of new issues, and development of corrective actions for unacceptable deviations from performance norms.
- Implement the process for obtaining Approval of Preliminary Baseline Range (CD-1) and Performance Baseline (CD-2).

Project Planning involves (1) development of a formal project charter and subsequent Project Execution Plan, and (2) expanding the Integrated Project Team. At this point management responsibility shifts from the program office to the project manager, and the contractors.

Prior to the commencement of conceptual design, include the following in project planning:

- Mission need
- Minimum technical functional and operational requirements
- Proposed scope, schedule, and cost ranges
- Preliminary environmental strategy
- Planning for the application of systems engineering (including value engineering)
- Identification of project technical and organizational interfaces
- Integration with other projects and activities
- Technical and process development efforts.

Prior to the commencement of execution, include the following in project planning:

- Project objectives
- Scope, schedule, and cost baselines, including contingencies
- Life-cycle cost analysis
- Preliminary safety assessment
- Project controls, including baseline change control, change control thresholds, and statusing
- Low-level procurement status
- Completion of National Environmental Policy Act (NEPA) documentation prior to final commitment to an alternative
- Performance criteria through test, startup, and its verification and evaluation
- Testing, turnover, and startup
- Design, cost, and schedule alternatives
- Technical and process development status
- Configuration control
- Records management.

Other project planning documents should be included in the formal plan based upon the needs of the individual project. Detailed guidance for generation of these plans can be found in Practice 4, Project Execution Plan.

7.1.1 Project Charter

A project charter should be issued by the PSO to formally recognizes the existence of the project. The charter includes a description of the project mission and a description of the product or service the project will create. The Federal project manager and other key project personnel are identified in the charter along with a brief outline of individual responsibilities. **The project manager shall be held responsible and accountable for ensuring the successful completion of the project.**

7.1.2 Project Acquisition

A proposed project organization will be defined by the Federal project manager and included in the PEP. A proposed contractor project organization will be defined by the contractor project manager. This will also be included in the PEP. As far as practicable, the two organizations should consist of personnel having similar technical responsibilities. Both definitions should include the organizational structure; identify the project manager and other key personnel; define individual roles, responsibilities, authorities, and accountabilities; and define division authorities for the project manager.

The project charter (1) provides the project manager with the authority to apply organizational resources to project activities, and (2) should be included in the PEP when drafted.

7.1.3 Integrated Project Team

The Integrated Project Team (IPT) (described in Section 5.1.11) may be expanded/ reduced/modified by the Federal project manager as necessary to support each project phase. Contractor support, as identified in the Acquisition Plan, will be identified and obtained, and the Contractor project manager assigned as a member of the IPT. The contractor's project team will similarly change as the project progresses and project needs change.

Project roles and responsibilities of the DOE and contractor members of the IPT shall be defined and documented in the PEP and/or formal memoranda of understanding if not covered in the PEP. Job descriptions for IPT members should be developed and issued.

Additional specific personnel resources required to accomplish project objectives, scope, schedule, and cost are identified and assigned as IPT members. These include a cross-functional group of personnel from safety, environmental, quality, and operations or, appropriate facility user disciplines.

As the project progresses from the conceptual to the turnover, the IPT expands, contracts, and evolves. Some early members might not continue past their initial purpose. Resources to consider include the following:

- Operations/Maintenance/Construction
- Safeguards and Security
- Environmental, Safety, and Health
- Financial Management
- Contracting/Purchasing
- Legal

- Engineering
- Waste Management
- Quality Assurance
- Human Factors Engineering
- Radiation Engineering
- Budgeting/Project Control.

7.2 INTEGRATION

A project manager has three general responsibilities on a project: resource management, planning and control, and coordination. Project integration is the summarization of these responsibilities. It involves processes of leadership, planning and execution that keep a team focused on completing the project.

Project integration is the heart of project management. The work of multiple organizations performing numerous interdependent tasks must be carefully planned, integrated and executed if the project is to succeed. This work involves a dynamic process. Maintaining the project focus requires leadership, management abilities, common sense, technical ability, and hard work. Because project integration involves planning, execution, and control, these next sections discuss the Project Execution Plan, project execution, change control of configuration management, and project turnover.

7.2.1 Project Execution Plan

Development of a formal, detailed Project Execution Plan (PEP) by the IPT shall be performed for all projects. A PEP summarizes critical information and documentation necessary to manage the project. This plan uses the results from all the planning processes and combines them into a formally approved document used to manage and control project execution. The PEP is also the primary agreement on project planning and objectives between the Headquarters Program Office and the Field.

The Project Execution Plan is developed by the project manager using an integrated, systematic approach that ensures a project management system based on effective management practices that are sufficiently flexible to accommodate the size and complexity of the project. Organizational policies, constraints, and assumptions are also inputs into the development of the plan.

A structured planning methodology should be used to develop a PEP. Site-specific methodologies may exist at some locations, and government contracts may specify methodologies in some cases.

Steps to consider in preparing a PEP include

- organizing and preparing a WBS and WBS dictionary.
- identifying and sequentially organizing project and activity durations.
- identifying project participant's authorities and responsibilities.
- performing critical path calculations and establishing project duration.
- interfacing the organizational breakdown structure with the WBS.
- establishing a progress (performance) measuring system.
- communicating results, reviews, and revisions.

Once the project planning methodology is established, the combined skills and knowledge of project team members and external stakeholders are used to maximum advantage in developing the PEP. The project manager builds the team as they build the plan, developing both mutual consensus and a sense of ownership.

As more project information becomes available, the PEP changes. To support Critical Decision-1 and -2, a draft Project Execution Plan and final Project Execution Plan are required and maintained current.

The elements of the PEP include the following (DOE O 413.X)

- Mission-need justification/project objectives
- Project description
- Organizational structure: roles; responsibilities, authorities and accountabilities including decision authority for Headquarters, field element, program and project management; and accountabilities including a formal memorandum of understanding
- Resource requirements
- Life cycle cost
- Integrated Safety Management Plan
- Project scope, schedule, and cost baseline ranges/performance baselines
- Description of the baseline change control process
- Risk management plan including risk analysis and risk handling, and contingency

- Project controls system and reporting system
- Acquisition Plan or procurement plan
- Alternatives, tradeoffs
- Technical considerations, particularly technical and process development efforts; environment, safety and health; configuration management, and systems engineering

7.2.2 Project Execution

Execution comprises the longest and most costly phase of a project and is the phase where controlling, directing, progressing, and reporting are most important. Project execution includes project phases that extend from the completion of conceptual design to turnover for operations. Execution thus extends from CD-1 to CD-4, and includes preliminary design, final design, construction, testing and turnover, and is the summation of these activities with completion of the deliverables.

The process of project execution will require the project manager to coordinate and direct the various physical, contractual, technical, financial, and organizational interfaces that exist during this time. This is particularly important because the execution phase is the portion of the project that requires the most resources and when mistakes result in the greatest schedule and cost impacts.

The success of the construction and turnover portions of project execution are dependent upon decisions made during the design. Therefore, the project manager needs to maintain an awareness of the design philosophy being pursued; design products planned; contracting/purchasing practices, methods and procedures; environmental, safety, health, and quality requirements; fabrication and construction practices; closure of construction and procurement contracts; and SSE checkout, testing, and acceptance. Because of these varied and demanding requirements, the IPT is at its greatest number and has its greatest diversity during the execution phase of the project. The execution phase is also the project phase that requires that a project manager (and the IPT) be given (1) significant project authority and (2) support of upper management.

The success of an execution phase is dependent upon design efforts: preconceptual, conceptual, preliminary and final design. No amount of careful construction management or contacting can guarantee success if the design is flawed. This is because the products of the design—defining requirements, developing baselines, and developing planning for the remainder of the project—form the basis of all future project activities.

For the above reasons, construction management plan is heavily dependent upon the design phase of the project. And this is the reason that the IPT needs to include construction, maintenance, and operations-type personnel throughout the design process. The intent of these “precautions” is that approval of significant design or scope changes after preliminary design may be difficult to implement, since hardware is impacted and changes require the review and approval of the change control board.

During the construction phase of the project, the important elements for success include

- clear contract, procurement, and construction contractor requirements.
- effective management and control of scope, schedule, cost, and contingency.
- efficient change control.
- well-planned commissioning and acceptance.
- oversight and management of subcontractors and vendors.

In order to assist the project manager and the IPT to perform their assignments, the following systems are available for their use:

Integrated safety management system. Assures that safety is included in all project planning documents, especially construction work packages. Required ISM practices are imposed on all project suppliers, contractors, and subcontractors, as appropriate. And finally, that safety audits are implemented, and incidents and accidents are promptly and adequately investigated, learned from, and reported.

Quality management process. Provides assurance that necessary quality features are included in design documents; audits and appraisals to identify system deficiencies are performed, documented and tracked to closure; inspections are performed as required; deficiencies are noted and corrected; and project deliverables meet project mission requirements.

Resource management process (Section 7.1.4). A structured system that continually evaluates the resources available to the project and compares availability to forecasted project needs. This process continually attempts to identify qualified personnel to assist in project execution.

Configuration management process. Assures changes to established project baselines are documented, evaluated, and considered at the proper management level for acceptance or rejection. This system also documents all requests-for-changes, justification for changes, and final decisions concerning changes.

Each project should insist that any individual requesting a change become the "sponsor" of that change and be responsible to complete the change request form identifying scope, schedule, and cost impacts to the project and any associated activities. The use of a change-request checklist is encouraged. Configuration management should also assist in preparing, documenting, and submitting CD requests.

Documentation and data management process. Assures that all essential project documents are prepared, identified, reviewed, approved (as appropriate), reproduced, distributed, filed, and dispositioned at project completion. Also assures that only the latest versions of approved design and construction documents are being used. The documentation process should assure the completion of design reviews, prompt response to review comments, and track comments towards closure.

In addition, this process should assure the receipt of specified contractor, subcontractor, and vendor data, and its review, approval, and acceptance. This process will prove especially valuable during the turnover and project closure activities, particularly in obtaining as-builts of all structures, systems, and components.

Two major functions of the project manager and the IPT is to prepare project status reports and to prepare and present project status review meetings. Properly planned and presented, these efforts reduce the number of information requests imposed on the project. These two activities are to be timely, informative, and accurate.

7.2.3 Configuration Management and Change Control

Configuration Management is a formal, documented change-control system. Rigorous surveillance and control of project baselines are warranted for even simple projects. Configuration Management includes identifying and documenting the functional and physical characteristics of an item or system; controlling changes to such characteristics; recording and reporting a change and its implementing status; and auditing items and systems to verify their conformance to requirements.

The project manager shall control changes to ensure changes are identified, coordinated and communicated, and that each approved change benefits the project. Project management is dynamic and following a predetermined plan is insufficient. **All change requests shall be documented, evaluated for project impact, approved and reconciled with the approved project baseline before physically implementing a change.** Further discussion is provided in Section 14.

Change control systems shall include Change Control Boards (CCB) that are responsible for reviewing and approving or rejecting change requests. The authority and responsibility of a CCB shall be defined in the CCB charter and agreed upon by key stakeholders.

Opportunities to improve performance, lower cost, or shorten schedule often arise during project execution. Alternatively, issues arise during project execution, some of which can threaten the success of the project. When an issue or opportunity occurs, time should be taken (1) to identify and understand the issue (2) gain opinions on what the actual issue is and (3) understand the possible consequences of alternative actions. When an issue arrises, a course of action should be identified; consensus sought; and corrective action plan developed and implemented. To minimize the number of major changes, and promote program stability, issues should be resolved as quickly as possible.

7.2.4 Project Turnover

The project manager, with the support of the IPT, shall establish a turnover, occupancy, stakeholder acceptance, and user-acceptance process that includes punchlist item resolution, user walkthroughs, and verification of requirement compliance and system startup for proper operation. An early turnover activity should be a memorandum-of-understanding with a user to document the extent of the turnover package; for example, spare parts, manuals, procedures, vendor data, and so forth.

Structure, system, or component checkout and testing is demanding, and rewarding as the project team realizes success as structures, systems, and components are tested and accepted. A key activity is the preparation and approval of test procedures, and the organization of test teams. Procedures are prepared by personnel who are part of the test teams. User organization personnel are also part of the test teams. An important concept of acceptance testing is "Don't lose momentum!" When testing begins, the project manager assures testing continues safely, to the extent possible, without interruption.

The project manager and the IPT remain involved, as requested, in the Readiness Assessment/Operational Readiness Review process. This makes those efforts more efficient in time and resources.

The project-execution phase is challenging and may be frustrating, but is rewarding. A key to a project's success during this effort is detailed continuous advance planning, good communication, qualified support personnel, and remaining fully committed and involved.

7.3 REVIEWS

Reviews are part of the planning process and are used to assist the project manager in developing project plans and validating that the project mission will be met. Reviews provide information to help make decisions, and demonstrate and confirm a project's accomplishments at various stages. The objectives of reviews include:

- Ensure readiness to proceed to a subsequent project phase.
- Ensure orderly and mutually supportive progress of various project efforts.
- Confirm (1) functional integration of project products and (2) efforts of organizational components.
- Enable identification and resolution of issues at the earliest time, lowest level, and lowest cost.
- Support event-based decisions.
- Control risk.

7.3.1 DOE Project Review

Peer and/or independent reviews are an important project management tool and serve to verify the project's mission, organization, development, process, baseline, progress, etc. Reviews may be initiated internally by the project to provide assurance of a particular technology or other facet of the work, or may be independent and conducted by an external, nonadvocate, organization. Reviews may be scheduled or unscheduled to meet a specific objective or need to a particular project event such as a budget validation or a request for a CD. The scope of a review is dependent on the cost/complexity of the project and its current status.

The project may also experience reviews that are initiated by other governmental agencies, such as the Government Accounting Office, Office of the Inspector General, Defense Nuclear Facilities Safety Board, or others. These reviews need to be conducted with as little impact to the project as possible.

For all projects, the appropriate AE conducts a quarterly project performance review with the Federal Project Manager and staff. The contractor may participate in this review as appropriate. OECM is invited to participate in all performance reviews for projects with a TPC over $5M.

For MS projects the PSO participates in the review process; quarterly reviews for other projects with TPCs of less than $100M may be delegated to a program manager or operations office/field office manager.

The DOE recognizes that independent reviews are valuable in assessing the status and health of its projects. An independent review is conducted by a non-proponent of the project. Independent reviews may be combined for efficiency, as appropriate.

7.3.1.1 External Independent Reviews

An External Independent Review (EIR) is conducted by reviewers outside the Program. The OECM, in conjunction with the program and project, selects an appropriate contracting agency to contract for such reviews, excluding the M&O/M&I contractors. The EIRs are managed by OECM. OECM coordinates all such reviews with the appropriate PSO to define review scope, choose an optimal time during the acquisition process, minimize impact on the project of conducting multiple reviews, and evaluate credentials of potential reviewing organizations and individuals.

7.3.1.2 Independent Project Review

An Independent Project Review (IPR) is conducted by reviewers within the Department. The Deputy Secretary as SAE, or the PSO and the Operations/Field Office Manager and Program Managers and Federal Project Managers, can authorize or conduct IPRs as required. The OECM is included as an invited observer for all planned reviews. The PSO or operations office/field office manager may request IPRs for any project. The OECM coordinates the extent of participation on a case-by-case basis with the appropriate organization. Committee members of an IPR team are <u>not</u> drawn from the responsible program office within a program secretarial organization, related contractors from the project office, or a related funding program.

7.3.1.3 Independent Cost Estimates

The Independent Cost Estimates (ICE) are used primarily to verify project cost and schedule estimates and support the CD-2 process in establishing project performance baselines. ICEs are part of the performance baseline EIR. An ICE may be requested at other times and for other reasons. The OECM functions as DOE's agent to establish contracts for ICEs. The ICEs are documented in formal reports submitted to the SAE/AE by OECM. Each ICE is reconciled with the current program office estimate by the Federal project manager.

7.3.1.4 Types of Independent Reviews

The following reviews must be conducted on all projects over $5M:

- *Mission Need IPR*. This is a limited review of the project prior to CD-0. It validates the mission need and the funding request.
- *Performance Baseline EIR*. This is a detailed review of the entire project, including an ICE, prior to CD-2. It verifies the mission need; validates the proposed technical, cost, and schedule baseline; and assesses the overall status of the project management and control system.
- *Execution Readiness EIR or IPR*. This is a general review of the project prior to CD-3 that may range from an abridged review of specific areas within a project to a comprehensive review of the entire project. As a minimum, it verifies the readiness of the project to proceed into construction or remedial action. This review is an external review for MS projects, and an internal review for other projects. **OECM shall be provided the IPR report for preview prior to the critical decision meeting.**

7.3.2 Project Reviews

Reviews communicate information on current status, progress, completeness, correctness, or work completion. Reviews include users, suppliers, contractors, managers, stakeholders, and peers. **Under the direction of the project manager, the project shall organize, schedule, and present project reviews based on user needs (tailored approach).** One or more of the following types of reviews are performed in support of DOE projects:

Regular/Periodic. Involves project status, trends, and design progress for systems and interfaces, quarterly reviews, peer reviews for development work, and so forth. All are an integral part of ongoing project activities.

Special Areas of Concern. Involve critical technology, hazards—some of these reviews can be planned and budgeted in advance, others will be on an as-needed basis. All such unplanned reviews are funded from "contingency."

Event-Driven. Involves mission validation, SAR, baseline validation. These reviews are necessary to obtain approval to proceed to follow-on project phases. These reviews are an integral part of a project and are planned in advance; most are performed by independent panels.

Unscheduled. Could involves GAO, DNFSB, DOE HQ or the user. Generally performed on projects with high congressional visibility or projects that experience schedule or cost difficulties. For large visible projects, these reviews should be anticipated and planned, including both schedule and cost.

Reviews are an important project activity and shall be planned as an integral part of the project, based on project complexity, duration and Critical Decision points. Additional reviews may be requested by the user or management. The project manager must establish a balance between a need-to-inform and the cost of reviews.

Reviews determine if a product (drawings, analysis, or specifications) is correct and will perform its intended functions or meet requirements. These reviews are peer or internal reviews and are an integral part of the project test and evaluation effort and should be planned as such.

Reviews are also performed to determine the current condition of a project or activity. For example, progress towards completion, compliance status, or readiness to proceed. Reviews could include items (project baseline, requirements, subsystem, or the project end product), or activities (planning, design, or construction). These reviews can involve management and/or the user. Products from these reviews include review plans, review reports, action item lists, and action item resolution reports.

Reviews are generally organized and provided by project personnel, including contractor and subcontractor personnel. Others are used when needed by technology experts, engineering management, senior management, the end product user, and appropriate stakeholders. A review has a specific objective and the performers plan the review to meet the objective. Review information is generally presented in a meeting setting with the review participants questioning the presenters to assure a thorough understanding of the material. Unresolved issues are placed on an action-item list and the action assigned to individuals for resolution within a specific performance period. A review report is prepared. It summarizes the results of reviews and includes a list of unresolved or open issues and responsible personnel. Resolutions of unresolved issues noted during a review are documented. Critical design reviews, CD-0 through CD-4, are held during a project life cycle. This assesses the status of a project in order to obtain an approval to proceed to the next phase.

7.3.3 Technical Reviews

Technical reviews are necessary when uncertainty exists about the outcome of a project effort. If a design is new, untried, or unproven, and no standards against which judgements regarding viability can be made, then a review by appropriately trained and knowledgeable peers is in order. Specific types of reviews can include:

- Alternative Systems
- Constructability
- System Requirements
- System Functional
- Preliminary Design
- Detailed Design
- Technology
- System Verification
- Physical Configuration Audit
- Test Readiness
- Functional Configuration Audit
- Operability and Reliability, Availability, and Maintainability (RAM).

7.3.4 Decision-Point Reviews

Decision-point reviews verify that sufficient (often prescribed) progress is achieved, level of information is developed, and requirements are satisfied to effectively initiate performance of subsequent activities.

The nature of decision-point reviews (excluding CD reviews) can be project-control-systems oriented, technically oriented, or both. The higher level the decision, the greater the need to have a mixed review. Depending on the project needs and the purpose, the scopes of decision-point reviews vary; they can range from simple reviews of minor project elements to critical decisions of which five exist. The five project critical decisions are described in Practice 14, Critical Decision Packages.

This page is intentionally blank.

8 SYSTEM/VALUE ENGINEERING

The primary goal of the systems engineering process is to transform mission operational requirements or remediation requirements into system architecture, performance parameters, and design details. Beginning with the definition of a need, the systems engineering process is viewed as a hierarchy that progresses through a baseline and ends with verification that the need is met, including interfaces, fit, and completeness. The application of systems engineering to a project is tailored to the project's needs.

8.1 INPUTS TO SYSTEMS ENGINEERING

The purpose of the mission need definition process establishes a foundation for proceeding with a project by understanding, confirming, and documenting the mission-need being addressed and the criterion for success. The initial state (current situation) and the desired final state (desired outcome) is defined, along with a high-level set of project deliverables and performance requirements that change an initial state to the final state. The mission need definition is completed in order to reach CD-0, and all documents should be provided to the project manager. **A project manager shall review CD-0 documentation and ensure top-level deliverables and/or functions have been defined.**

8.2 FUNCTIONAL ANALYSIS

Shown in Figure 8-1, Functional Analysis and Allocation, is the iterative process of breaking down top-level project deliverables or functions into successive levels of subfunctions.

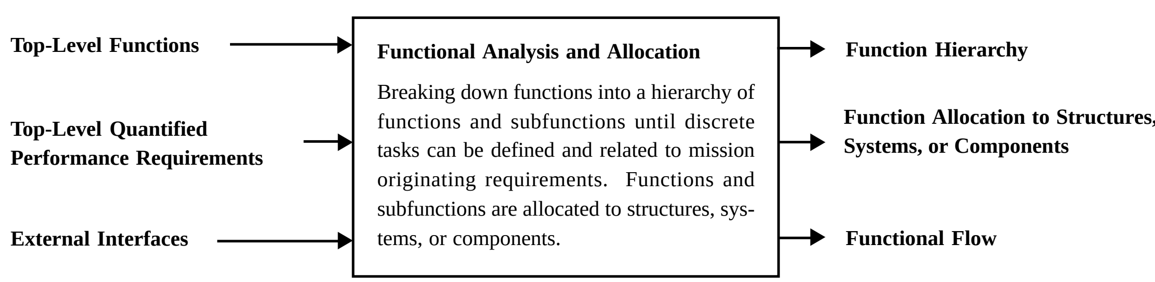


Figure 8-1. Functional Analysis and Allocation

A project manager performs this analysis to develop the subfunctions that are necessary and sufficient to accomplish the top-level functions. These subfunctions form the key input for the Work Breakdown Structure (WBS).

The WBS is a deliverable-oriented grouping of all project elements (technical and nontechnical) shown in graphic display to organize and subdivide the total scope of the project. The top-level set of functions are defined and documented in the preconceptual design phase. As the activity progresses through the conceptual and the preliminary design phases, initial functions are decomposed at each level into subfunctions to identify all the necessary and sufficient subfunctions to accomplish the parent function. This is an iterative process that occurs as more information becomes available, such as studies and design selection.

At each level (system, subsystem and component), subfunctions are identified based on the functions, requirements, and resulting design decisions from the previous level. As the level of detail increases, the subfunctions are allocated to systems, subsystems and/or components.

For complex activities, a functional hierarchy diagram may be used to depict the breakdown of functions into subfunctions. Also, a functional flow block diagram may be generated to show the logical relationship of functions or subfunctions at the system or subsystem level (See Practice 13). The functional flow diagram may be used as a tool to analyze and model system behavior. An allocation matrix can be used to document which system, subsystem, or component performs the function and subfunctions.

8.3 Requirements Analysis

Requirements Analysis is conducted to identify the necessary and sufficient set of performance requirements, design constraints, and interface requirements for each function. Generally, the project manager would perform this analysis for each identified function.

Performance requirements state how well the solution should perform the function. Requirements may be imposed on the design solution (design constraints) or be related to interfaces between systems (interface requirements). Identified requirements may result from the functions and requirements from the next higher level, or derived from an alternative study. **Regardless of the source, each requirement shall have a documented basis.** The depth to which this type of analysis is conducted for a given project is based on project risk and complexity, consistent with the depth of functional analysis performed. It may be performed at each level for large projects or at the system level for small low-risk modifications.

The requirements analysis and allocation step is illustrated in Figure 8-2.

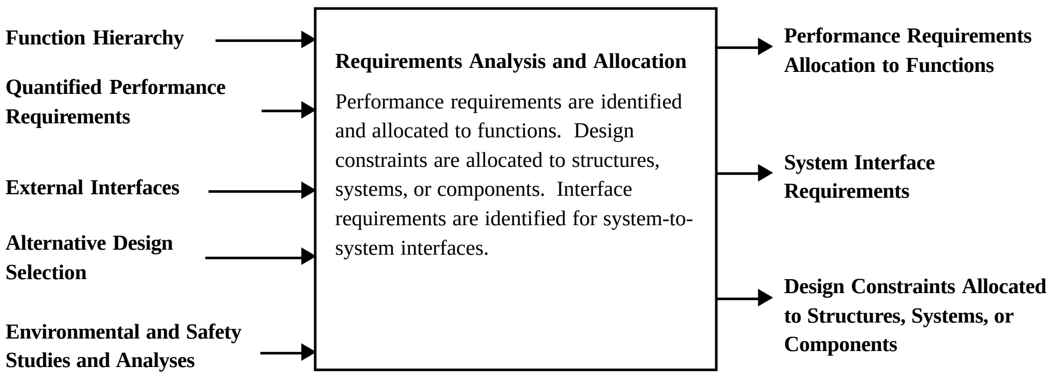


Figure 8-2. Requirements Analysis and Allocation

An initial top-level set of requirements is established and documented during the preconceptual design phase. Additional detailed requirements are developed during the conceptual and preliminary design phases.

Design constraints identified for systems are typically traceable to national codes and standards, DOE Orders, specific site standards, permits, Federal and state regulations and statutes, trade-off/alternative studies, and experience with similar systems. Because design constraints constrain the design of structures, systems, or components; they are allocated to structures, systems, or components rather than to functions.

The characteristics at the interface of two systems are used to identify and impose requirements (Examples: functional, performance, constraints or physical) on the interfacing systems. These are identified as interface requirements.

Practice 13, System/Value Engineering, provides a complete description of the methodology for conducting alternative studies, inclusive of guidance on appropriate level-of-effort activities.

This page is intentionally blank.

9 ALTERNATIVE ANALYSES AND TRADE-OFF STUDIES

Alternative analyses and trade-off studies are performed to select subfunctions that satisfy established performance requirements. A synthesis process translates the functional allocation into a physical architecture by grouping functions and subfunctions into logical physical elements that will make up the end product. These physical elements are composed of hardware, software, material, data, facilities, people, services, and/or processes. Alternatives are analyzed to determine which best satisfies allocated functional and performance requirements, derived requirements, interface requirements, and constraints. A synthesis process defines and integrates physical architecture to a level of detail that enables verification that the functional and performance requirements have been met. The process translates the architecture into specifications, baselines, and a Work Breakdown Structure (WBS).

9.1 ALTERNATIVE STUDIES

As necessary, the project manager should obtain alternative studies and provide recommendations as to which of the alternate "methods" should be included in a given project or activity. An alternative study can be simple, requiring little effort and minimal documentation, to one requiring time, effort, and extensive reporting. The less the consequences of selecting one alternative over another, the less justification needed (See Figure 9-1).

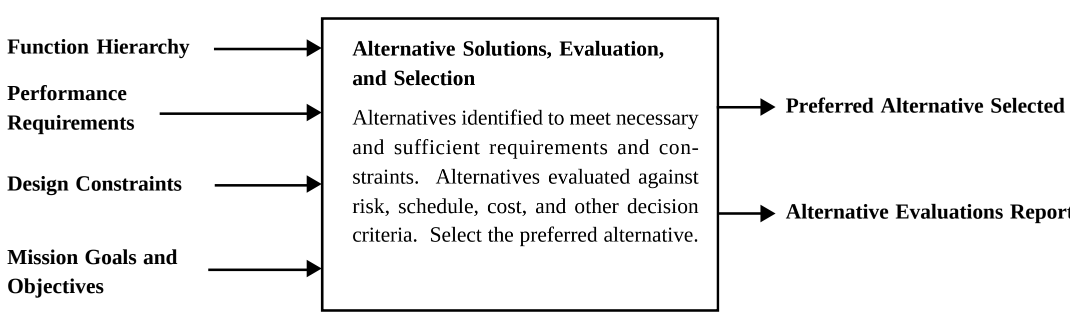


Figure 9-1. Alternative Solutions, Evaluation, and Selection

Within the DOE process of project management the use of alternative studies is an integral part of the planning process. Alternative studies take the defined scope and establish a validated design.

Alternative studies are to be tailored to the intended application, inclusive of timing within the framework of the activity. Alternative studies are applied at all stages of the design process and may even be applied at the individual system level or component level. At the initial project level, the study should fully consider all life-cycle cost impacts as input into making final decisions concerning which alternative to pursue.

The alternative study process is a THREE-step process at minimum, as follows:

(1) delineate the deliverables or function and requirements that are required

(2) identify alternatives that can meet the deliverables or function and requirements

(3) evaluate and select one of the alternatives.

For slightly more complex decisions, these steps are augmented with the establishment of criteria to be used in making the alternative selection. These criteria are selected such that they are independent of each other and provide a distinction among the alternatives. Criteria is selected based on goals, objectives, and requirements. For highly complex applications, criteria are weighted to establish their relative importance in the decision-making process. Alternative studies are generally reported as a section of the PEP or as an Alternative Study Report.

9.1.1 Value Engineering

A value engineering (VE) study is an alternative study. This study evaluates if there is a "better" value approach than the approach currently specified. Value engineering requires that a technical approach has been already selected. The project manager should employ value engineering studies where appropriate, particularly to differentiate between repair, upgrades, new capability, etc.

A value engineering study is not synonymous with a cost cutting activity. However, this conclusion is a natural observation about any activity geared toward a "better" approach than that currently baselined; "better" usually meaning less costly. The term baseline is not limited to the traditional definition of having firm commitments, via CD-2 approval. Instead, this means that a preferred choice is identified and is being used as a basis for ongoing project work. By contrast, at the same stage of design, an alternative study has not yet selected a preferred approach (or the preferred approach has been determined to be unsuitable).

One distinction between VE and other alternative studies is that alternative studies are focused at a specific project level and often impose restraints on the alternatives to be considered. In value engineering, the life cycle of an activity (Example: mission definition through decommissioning) is to be considered. The only constraints that should be considered in VE are those identifying the starting point for the study scope.

Consistent with the concept that VE is based upon identifying alternatives to the current approach, the optimum timing for use of VE is between conceptual and preliminary design. Earlier than this there is usually insufficient detail to enable a full-scope evaluation (Example: from mission identification through decommissioning). Later than this there is often such an extensive investment in the selected approach that even highly valuable alternatives have insufficient benefit due to the effort required to implement the change, as opposed to the effort remaining as is.

Practice 6, System/Value Engineering, provides a complete description of the methodology for conducting alternative studies, inclusive of guidance on appropriate level-of-effort activities.

9.2 Design Validation and Verification

A design validation and verification activities are conducted during the project life cycle to ensure that a project meets the defined mission by fulfilling the identified functions and requirements. *Validation* focuses strictly on the requirements and ensures the right problem has been defined. *Verification* focuses on the design solution for the validated requirements and ensures that the problem is solved. The formality and rigor of the conduct and documentation of validation and verification are commensurate with the associated risk, and the complexity of structures, systems and equipment.

9.2.1 Design Validation

The project manager should validate that the developed requirements are complete and technically adequate with respect to the mission, and are consistent with each successive developed layer of detailed requirements. This is done by assuring that requirements flow down from the facility to systems, to appropriate components, and finally to a task. Validation (1) includes a completeness check of the system-to-system interface requirements, and (2) ensures that these interface requirements link to an appropriate interface control documentation where necessary.

9.2.2 Design Verification

The project manager shall verify selected solutions meet validated requirements for high-risk structures, systems, and components. Verification methods that can be used include analysis, design reviews, system and component testing, and proof-of-principle demonstration testing. The rigor of verification performed is based on risk. Selected high-risk components can undergo several design reviews as well as testing to mitigate uncertainties associated with the identified risk. Also, proof-of-principle design demonstrations can be used for selected high-risk items where the test results help to define requirements and refine the final design.

9.2.3 Post Construction Verification

After construction, the project manager shall test and inspect systems in accordance with the validated requirements and developed functional acceptance criteria. Post construction verification ensures that functions and requirements are fulfilled; installed components work together as intended; and working systems perform as prescribed by mission needs. Post construction verification is usually accomplished through testing.

10 TECHNOLOGY DEVELOPMENT

Technology development identifies technology goals and develops, demonstrates, and implements new technologies that support the project mission and reduce project risk. Technology development provides sufficient design input to permit detailed design. An early problem indicator of a need for a technology development program is the risk analysis result(s). A second important indicator is the inability to define or meet project functions and requirements.

To resolve these problems, a technology development program is implemented that is well defined and structured, yet flexible. This is achieved by establishing goals and objectives, including a clearly defined path for technology development activities, and the completion and turnover of deliverables.

10.1 TECHNOLOGY DEVELOPMENT PLAN

For projects requiring technology development, the project manager develops a project-specific Technology Development Plan and incorporates it into a PEP. This plan is kept current as long as technology development activities described in it are being conducted. The format of a plan follows the outline provided in Practice 5, Technology Management. Variations on this approach, such as roadmaps, decision matrices, and so forth, may be used when deemed appropriate by the project manager or an assigned technology development manager.

Because of the need to maintain flexibility in technology development, the implementing process can <u>not</u> be overly prescriptive. There are key points to consider in order to keep a process focused and controlled, as follows:

- Establish goals and objectives.
- Define scopes and responsibilities.
- Identify deliverables to be completed prior to starting project design.
- Allow structured flexibility to evaluate alternatives and adjust to process and equipment development findings and failures.
- Clearly define any required test, including anticipated results.
- Define developmental risk and uncertainty.

- Establish a schedule for completing technology development activities.
- Complete technology development tasks early in preliminary design; Proof-of-Principle tasks can continue into final design but should be considered high risk.
- Manage the technology development program as a WBS element and as a subcontracted effort; that is, change control and program reporting.
- Link development actions to information needs: functions, requirements, risk, and design.
- Control changes to the technology development plan.
- Periodically review the technology development program, preferably at the completion of each project phase. A review should focus on project/design maturity and research peer review.
- Establish a format and process for submitting technology development results to the project
- Define the level of technology development support required after the planned technology development is complete.

Other sources of information that help define a technology development program include:

- Project mission statement
- Project schedule
- Project Execution Plan
- Lessons learned from other DOE projects

Participation in technology development varies based on the nature of the technology being developed and the phase of the development activity itself. Generally participants include:

- Technology development organization (serves as task lead for planning and implementing technology development activities).
- Design authority
- Program manager
- Project manager

- Engineering (Design and Systems) and project controls
- Specialists
- DOE
- User

The results of a technology development activity are intended (1) to identify new technological approaches to resolve existing problems, and (2) to verify that a technology is adequate. Establishing user expectations is essential to ensuring that appropriate measures are established and pursued to solve the problem. Primary customers include the following:

- Design authority
- Design engineering
- User
- Project manager
- DOE

10.2 TECHNOLOGY DEVELOPMENT FINAL REPORT

Upon completion of the technology development activity, a technical report is provided that documents the results of the development activity and the recommendations for the project's path forward. This report includes any design, construction, operations, and maintenance constraints that are identified. The report should also identify the impact of results and recommendations on a project's schedule and cost.

This page is intentionally blank.

11 RISK MANAGEMENT

Throughout a project, risk management is used as a major input for a quantitative evaluation of the probability of successfully defining and implementing the activity. This evaluation begins at the “mission” level for new ventures, sequentially proceeding through implementing projects, subprojects, and other activities. At each step, the evaluation is an estimate of the potential impact that risk could have on activity and defines strategies about how to best proceed.

Key decision makers should understand the nature, quantity, and impact of risk in order to make informed decisions.

The benefit/cost analysis and thus the decision to proceed with an activity is influenced by the risk involved. Such a decision needs to include a clear understanding of the mission to be accomplished and why this mission needs to be implemented. Risk decisions should include stakeholder input.

11.1 PROCESS

Risk analysis follows a six-step process: risk awareness, risk identification, risk quantification, risk handling, risk impact determination, and risk reporting and tracking. See Figure 11-1.

Risk mitigation activities (subsequent to those at project preconceptual planning) are the responsibility of individuals identified in the Risk Management Plan. These responsibilities do not change unless the Risk Management Plan is revised.

11.1.1 Risk Awareness

The project manager shall develop a Risk Management Plan. This plan (1) identifies the scope of the project’s risk definition and defines interfaces with other entities, for example, other projects, facilities, and organizations, (2) delineates the methodology that will be used to identify and quantify or assess risks, (3) assigns personnel and/or organizational responsibilities, and (4) provides risk tracking and closure mechanisms. For smaller projects, the Risk Management Plan may be included in the PEP.

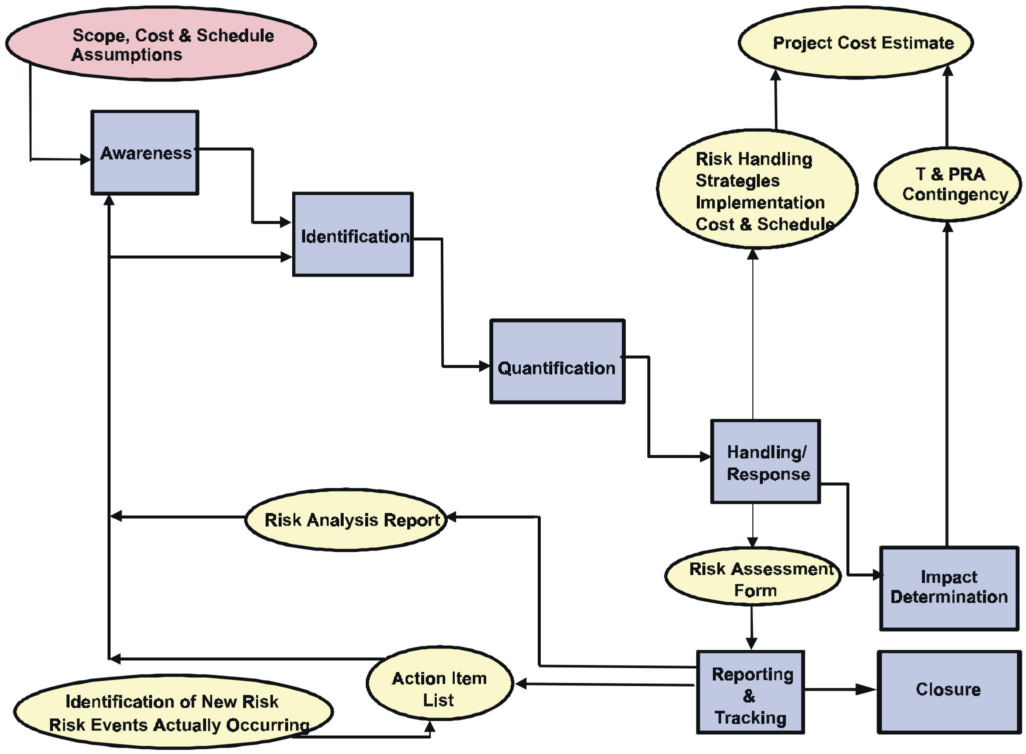


Figure 11-1. Risk Management Functional Flow Diagram

The Risk Management Plan is maintained throughout the life of a project, including updating references and basic information to reflect prior risk assessment activities. As compared to the initially developed plan, other planning changes may be appropriate, depending on how the project is evolving . However, the Risk Management Plan is developed once and then periodically maintained.

11.1.2 Risk Identification

Risk identification is initiated through risk screening. This screening, performed against an established set of trigger questions, (1) identifies significant potential risks associated with a project and (2) focuses on the ability to design and execute the proposed project and to operate the resultant facility.

The process identifies "potential" project risks (e.g., cost, schedule, technology), preparing clear-risk statements with corresponding bases as flagged in the risk screening step. When defining risks, the level of detail is commensurate with the stage of the project. For example, during project preconceptual planning, new technology is being considered. In describing this risk, it can have applicability not only to the technology area but also to the potential resources, design complexities, testing, interfaces—among systems and components within the project scope and with external entities, or procurements.

The degree to which these details are applicable to the project are unknown at the preconceptual planning stage. However for risk purposes, they should be "expected" and considered in risk evaluation and be identified as potential cost and schedule impacts even if there is only one risk identified. This is sufficient, since an early objective of a risk analysis is to establish a sufficiently accurate planning/ feasibility of scope, schedule, and cost to ensure that the program can be successfully implemented.

The difference in a risk identification process between an initial risk assessment and subsequent risk assessments is the level of detail expected as a project matures. As more information becomes available, previously identified risks are divided into discrete risks to better facilitate the handling and tracking of both risks and associated action items.

11.1.3 Risk Quantification

Risk quantification follows the process documented in the Risk Management Plan. Using one of the methods described in Practice 8, Risk Management, this is based on a combination of risk probability and consequence. If the initial process is revised, the new process selected is reflected in revising the Risk Management Plan.

11.1.4 Risk Handling/Response

For each identified risk, the risk handling strategy is reviewed to ensure that necessary action items are being developed and implemented. For each new risk identified, a risk handling strategy is developed.

Several tools exist to mitigate risks, including the following:

Cost. Involves contingency, value engineering, and constant cost reduction/cost control activities.

Schedule. Involves contingency, long-lead procurements, work-arounds, make/ buy decisions, and fast track (not generally recommended).

Technical. Involves technology development plans, laboratory tests and demonstrations, bench scale tools, and pilot-plant tests.

11.1.5 Risk Impact Determination

Each identified project risk has potential impact(s) on the project. Impacts should be documented. The potential for project impacts minimized by

- the incorporation of handling strategies intended to minimize the impact of an identified risk into the project baseline, and adjustment of the proposed baseline range (scope, schedules, cost) to reflect this incorporation.
- the development of a risk-based contribution to project contingency to reflect the anticipated cost associated with potential risks.
- the incorporation of anticipated schedule contingency into the integrated project schedule to reflect the delay associated with potential risks.

For smaller projects without an integrated schedule, scheduled delays can be converted into equivalent dollars based on expenditures per unit delay in time, and this should be included in the project budget. A risk activity recognizes that this practice serves to identify the cost of the delay. The process does not contribute to an improved forecast of the project end date.

11.1.6 Risk Reporting, Tracking, and Closure

Risk reporting is the documentation of risk identification, risk quantification, risk handling strategies, impact determination, and risk closure.

Risk tracking is the monitoring of action items from risk-handling strategies/ responses; the identifying of a need to evaluate new risks; the reevaluation of changes to previous risks.

Action items include assignment of each risk to a responsible individual and identifying a completion date.

Completion dates are tracked and each action item status updated through closure.

A tracking system is commensurate with the size and complexity of the project. This process follows the system prescribed in the Risk Management Plan. If deviations prove necessary, they are shown in a revision to that plan.

Detailed guidelines for risk handling strategies are provided in Practice 8, Risk Management.

12 ENGINEERING AND BASELINE SETTING

12.1 ENGINEERING

In preparation for initiating procurement and construction (execution) activities (CD-3), engineering consists of those actions that support the completion of the project design and its integration into the overall project. For example, approved design and procurement documents; engineering support during construction; and, specialty engineering. The project manager must be sufficiently acquainted with these activities in order to effectively implement and manage them during the execution phase of the project.

12.1.1 Basic Elements

The success of project execution and engineering management rests on five basic elements:

Competent People. Those qualified, experienced, and dedicated people, who form a "team," are the key element in any field of endeavor. Project execution and engineering management require people with superior competency in project management, systems engineering, accounting, and traditional engineering specialties, such as safety, security, reliability, and maintainability. The project organization should effectively integrate staff size and qualifications. The project should also provide effective training that provides and maintains knowledge and skills specific to the project.

Documented and Disciplined Processes. Project management and the technical processes should be defined, documented, and applied in a disciplined, tailored manner. Processes are tailored from proven general processes that are appropriate for the project. The responsibilities and accountabilities associated with each management and technical role is clearly identified including decision authority and change-control authority.

Project Structure, Methodologies, and Tools. The project structure, methodologies, and tools are defined, documented, and included in training curricula. The project structure provides facilities, tools, and equipment, and promotes communication among the entire project team. Methods of management and engineering are identified for a project and should provide support in performing and verifying various project tasks.

- *End Product Development.* **The project shall clearly define and document the end product(s) to be provided to a user.** A project defines and documents the processes (including procedures) to be used (if any), while providing the end product. Both the end product and the process meet requirements and perform functions that satisfy mission needs.
- *User/Customer Interactions.* The project should implement user interaction techniques and processes during development, delivery, and acceptance. The user should also be assured of a continuous interface with the IPT.

12.1.2 Engineering Principles and Process

Engineering performs evaluations to identify the best design approaches that use available hardware, software, and people to meet requirements. Project managers integrate the methods, techniques and processes used to communicate project procedures and engineering processes with the management, budget, and planning processes.

Project procedures that document the process to be followed throughout the execution phase are developed by the project manager prior to initiating project execution. A process should accomplish the following objectives:

- Transform mission, operational, or disposal requirements into a system architecture, performance parameters, and design details
- Integrate technical parameters to ensure compatibility among the physical, functional, and programmatic elements of a project
- Ensure that availability, reliability, maintainability, and operability requirements are met
- Ensure that safety, security, environmental protection, and human factor requirements are met
- Fabricate hardware, develop software, construct facilities, or perform remediations
- Inspect, test, and accept components and functional units that will be used in the end products

- Integrate components and functional units into end products
- Verify that all mission requirements are met
- Provide an end product demonstrating mission needs have been met.

During the preliminary design phase, a comprehensive, finalized Project Execution Plan (PEP) is submitted for approval at CD-2. The PEP at this stage defines how the execution and closure phase is conducted. During a project, implementing a PEP provides information about the following activities:

Management

- defined roles, responsibilities, and authorities of project personnel, including design and decision authority.
- identify key personnel by position, staff level, discipline, and qualifications.
- identify the major project activities with inputs, outputs, performance metrics, and completion criteria.
- the training curriculum and facilities necessary to establish and maintain staff qualifications, and indoctrinate all project personnel with project policies, procedures, and practices.
- funding request documents (e.g., Project Data Sheets, Activity Data Sheets, etc.) submitted each fiscal year for the Congressional budget.
- project scope, cost and schedule baselines, and planning for baseline management, including establishment of a change control process and change control thresholds.
- contracting and procurement plans to determine the scope of work best suited for performance by contractors, in order to request and evaluate bids and select contractors.
- construction management plan to establish a procurement-delivery system for construction of project facilities.
- a plan for monitoring, control, and oversight activities.
- a procedure for monitoring key project activities and identifying and controlling these activities to a target performance level.

- a procedure for project oversight to: identify and resolve new project issues, assess outcomes of project activities, and initiate corrective actions as necessary to assure acceptable results.

- scheduled and event-driven status reporting necessary to satisfy a project's monitoring, control, and oversight needs and requirements.

Engineering

- plan the engineering organization and staffing levels, including disciplines and qualifications.

- plan for configuration management control and records management.

- include workers, the public, environment, nuclear, industrial, and safety planning in all design efforts .

- plan to assure public and stakeholder inputs to baseline development, maintenance and changes.

- test, evaluate, and turnover the completed end products to the user, including as-built design drawings and specifications, vendor data and manuals, and procedures.

- provide the information for the Approve Start of Construction (CD-3) and for conducting the critical decision process.

- provide the information for the Approve Start of Operations or Project Closeout (CD-4) and for conducting the critical decision process.

- plan for transition to the user.

- plan for project closeout, including methods and activities for closing out the project after the operations phase has begun.

- provide appropriate plans, personnel lists, equipment lists, supplies, etc., as necessary, to demobilize the project.

- plan to integrate Specialty Engineering into the following engineering design effort:

  — Human Factors

  — Reliability, Availability, and Maintainability (RAM)

- — Inspectability, Manufacturability, Operability, and Survivability
- — Safeguards and Security
- — Risk Management
- — Value Engineering
- — Constructability
- — Environmental, Safety and Health
- — Configuration Management
- — Quality Assurance

► Perform test, evaluation, and acceptance plans to ensure the end product(s) meet or exceed design requirements, such as to

- — Outline the responsibilities of participating organizations, including inde pendent testing
- — Include rationale for the kind, amount, and schedule of project tests and inspections
- — Relate these efforts to technical risks; operational and maintenance concepts and issues; performance requirements; reliability, availability, maintainability; and critical decision points.

Specialty Engineering Integration Activities

Speciality engineering integration activities might consist of the following:

► a plan for environmental, safety, and health (ES&H) documentation to provide information on critical statutory, regulatory, and directive requirements necessary to develop the project's ES&H milestones and schedules. ES&H documentation should include policies, organization, training, safety analyses, environmental permits, reviews and audits, reporting of unusual occurrence and remedial actions, management procedures to protect the health and safety of employees and the public, and risks from hazards to life and property.

► A plan to provide for preparation of the required NEPA documentation (e.g., Categorical Exclusion, Environmental Assessment, Environmental Impact Statement). The plan should also provide for a review of the NEPA documentation determination from the conceptual phase to determine if the impact analysis is sufficiently broad or still valid for the execution phase.

- a plan for safeguards and security requirements, and the documentation necessary to develop and implement an adequate security system. Integrate the design into the end product.
- a plan for quality assurance requirements and documentation for both contracted and in-house work.
- a plan for configuration management requirements and documentation including organizational structure, responsibilities and authorization, technical baseline identification, configuration change control, and configuration recording and reporting.

12.2 Baseline Setting

Project baselines contain three elements: (a) a scope baseline (b) a schedule baseline and (c) a cost baseline. A scope baseline is developed first. This describes the desired configuration, performance, and characteristics of an end-product. The work necessary to provide the end-product is determined using a scope baseline. The scope-of-work is divided into elements that become the work breakdown structure (WBS). These elements are the basis for developing schedule and cost baselines. WBS elements are very tightly coupled; a change in one baseline may affect others.

Baseline ranges are identified and established at both the program (WBS) and project (CWBS) level. Baseline ranges are further detailed through expansion of the Work Breakdown Structure (WBS) and the WBS Dictionary to the cost account plan level. The cost accounting plan is the primary tool used to plan, control, and measure the execution of work.

Preliminary baseline ranges are established during the project conceptual phase. Approved performance baselines are established at CD-2. Management and control of approved baselines are the responsibility of the project manager. These baselines are quantitative expressions of planned technical, schedule, and cost workscope performances that serve as the basis and standard for measuring the execution of work.

The formulation and maintenance of baselines are guided by certain principles, include the following

1. Baseline elements are traceable to the Work Breakdown Structure (WBS) and WBS dictionary.
2. The technical scope baseline is derived from mission requirements and is used as the basis for establishing the schedule and cost baselines in accordance with system engineering processes, using a tailored approach.
3. The near-term portions of the baselines are detailed to a level enabling annual budget formulation.
4. The long-term portions of the baselines will evolve in detail and precision as work is executed, until they are approved at CD-2.
5. Baseline components are tightly coupled and a change in one element (scope, schedule or cost) will most likely affect other elements.

Any change to an approved baseline shall be thoroughly reviewed, understood, documented, and formally approved through a structured change control process.

During conceptual design, few details appear in the project baselines and may include only the performance directly related to program mission, some bare specifications, and an outline of the technical approach. As additional information is available, details are added, including end product and critical subsystem specifications and drawings, which lead to establishing the project performance baselines. For environmental cleanup, the initial performance and specification details focus on cleanup standards, requirements, and the associated regulatory and compliance drivers.

Baselines evolve in greater detail (until CD-2 approval) with experience, established designs, regulatory decisions, and work performed. During this time, changes to baselines are approved, documented, and implemented through a formal change control process; and after careful consideration of all scope, schedule, and cost impacts. To ensure integrity, baseline elements are traceable between the various levels at which they are described and controlled. For example, a key milestone on the top level (master) schedule is identified with the same description and start and completion dates as appear on the lower-level schedules, and in the cost account in which the work is performed.

The history of the maturing baseline is recorded through systematic configuration management that provides a reference for managing and evaluating the project. Configuration management ensures changes are made only after adequate review and that there is an audit trail of reviews and changes. The process of change control is distinct from the process of developing the baseline itself. The baseline change control process is used to manage baselines.

12.2.1 Scope/Baseline

Initially a scope baseline is derived from program or mission requirements. Baseline maturation occurs (during project preconceptual and conceptual design) from increasingly detailed studies resulting from improvements, changes, increased understanding or problems encountered. During each phase, the scope baseline contains sufficient detail to support the scope of work, and the schedule and cost baselines.

The scope baseline defines the desired end-product and includes at a minimum the following:

- Functional and operational requirements
- Specifications (for environmental projects, this may be a Work Breakdown Structure Dictionary)
- Drawings.

12.2.2 Schedule Baseline

A schedule baseline (including critical path definition and milestones) should reflect all project requirements including programmatic, operational, legislative, site, regulatory, compliance, DOE reviews, CD approvals, and institutional constraints. The baseline components should correspond to the WBS. The schedule baseline facilitates project planning, and the identification of time-phasing and logic relationships among subsystem activities, and with other projects.

The schedule baseline helps determine critical project activities and performance measurement criteria. This baseline should specify the time needed to complete work- scope elements, reach project milestones, and complete the project. Milestones, including key customer milestones, should be frequent, measurable and distributed evenly through time, so project performance can be continuously tracked and measured. **The schedule baseline shall be resource-loaded at the appropriate level to facilitate costing and budgeting.** The schedule baseline should include sufficient flexibility to allow for scheduling contingencies in response to risks, problems, or delays. To further define the schedule baseline, the project should negotiate lower-tier milestones with its vendors, suppliers, and subcontractors, which support accomplishment of the schedule baseline. Milestones should be defined on milestone description sheets, including deliverables and dates. Key milestones should also be included in a milestone control log, along with a completion date and, if appropriate, a responsible individual.

Schedule activities shall be activity-based when possible, with a strong relationship between schedule and cost estimate activities. Generally, near-term activities are more detailed than future activities. Activity duration is determined by those responsible for the activity. Duration times are based on historic experience or extrapolated from other similar activities.

12.2.3 Cost Baseline

The cost baseline is based on validated or independently verified project cost estimates. **The cost estimates shall be prepared using appropriate estimating methodologies.** Estimates should be consistent with the WBS, and the DOE cost structure as defined by the DOE, for all contract work. The project must ensure that all estimates are consistent with the guidance provided in DOE G 430.1-1, Cost Estimating Guide. The estimates will satisfy an analysis conducted under FAR clauses 15.403, Obtaining Cost and Price Data Analysis, and 15.404 Proposal Analysis, as applicable. Discussion on cost estimating is also provided in Practice 12, Scheduling and Cost Estimates.

Estimating the cost of a project in accordance with DOE Standards is required by DOE O 413.1. The DOE places importance upon the accuracy and validity of project cost estimates since they are the basis of funding requests. Cost estimates should be developed and maintained throughout the life of the project, using the most appropriate estimating technique.

During concept development, the cost baseline may consist of a single cost figure for the entire project. Later, for most large systems, and often for a particularly critical or risky subsystem, the baseline will be divided into the major subsystems (the first level of the WBS).

The cost baseline shall reflect all capital, expense, R&D, and outside funds required from preconceptual design to beneficial or user occupancy. The cost baseline shall also include escalation calculations using the DOE approved escalation rates.

12.3 CONTINGENCY

The application of contingency shall be considered in all scope, schedule, and cost baselines as being both prudent and necessary. Contingency is most often derived through a risk analysis of the work scope being estimated. This analysis includes scope, cost, schedule, and technical risks as they apply to the program/project efforts, underscoring the uncertainties existing in each element. The magnitude of estimated contingency (schedule and cost) depends on planning, design, procurement, and construction; and the complexities and uncertainties of the operation or component parts of the project or program element.

For less complete projects, contingency is often estimated as a percentage of a particular cost or category of work. Contingency should be estimated at an appropriate level based on a review of each major cost category/activity. A base estimate is a best effort to develop expected project cost. Then a contingency analysis is performed and the project contingency developed. Substantial projects should use Monte Carlo simulation and develop a probability-based risk analysis, which generates the bases for the contingency.

Contingency involves the following:

1. Contingency is estimated at an activity level or at a summary level. Preferably, contingency will be estimated as close to the activity level as possible.
2. Contingency considers the varying degrees of risk associated with various tasks
3. **Contingency shall <u>not</u> be used to avoid the effort required to prepare a properly detailed and documented cost estimate**
4. **Contingency shall be controlled, approved, tracked and documented, based upon established and approved levels of control**
5. Contingency is monitored and reported separately
6. **A schedule contingency shall be developed for each project task, with the amount of contingency assigned to the various activities reflecting the importance, cost, and difficulty of the task.** The individual contingencies will then be used to develop the project schedule contingency.
7. A process contingency (or margin) should also be included in project design, especially those having process systems, equipment, valves, lines, and vessels. (This contingency accommodates margins of error in process equipment sizing, and a prudent amount of "surge" in the process systems.)

Contingency is part of the expected cost at project completion and must be included in the TPC established as the performance baseline. Although contingency is consumed as project work is performed, the distribution of contingency is controlled through a formal change control process. **In addition, a contingency usage log shall be maintained to document contingency usage by date, purpose, and amount.** A contingency usage curve should be prepared and maintained to provide a clear visual history of contingency usage. Contingency usage and status should be included in monthly performance reports and discussed in status reviews.

12.4 Performance Baseline

The performance baseline (PB) represents the DOE commitment to Congress to assess Total Project Cost (TPC). The TPC baseline is a guide by which Congress assesses DOE performance and is a reference point for Congressional and GAO inquiries related to DOE project management performance. **Therefore, TPC baseline shall be established with a high degree of confidence so that project completion can be achieved within the cost and schedule baselines.** An element in formulating the performance baseline is a systematic risk analysis that identifies and assesses uncertainties related to project scope and design definition; and also the development and inclusion of adequate contingency to address factors that might cause cost/schedule growth during project execution. Project completion without an increase in the TPC is the primary measure of success in formulating the TPC performance baseline.

The TPC for the performance baseline shall be established at CD-2. If established earlier, it is done after careful consideration. Establishing a performance baseline earlier than CD-2 is a contributor to baseline growth. The project manager is responsible for project completion within the performance baseline.

In establishing the performance baseline, project completion shall be clearly and unambiguously defined. A primary consideration is whether project completion is defined as system/facility turnover to the user, or whether subsequent costs (operating and D&D) are included in the performance baseline (life-cycle approach).

From a Congressional accountability perspective, the Performance Baseline shall capture <u>all</u> project costs (Total Project Cost [TPC] includes both the capital and OPC [OPEX] components) even if the project is fully OPEX funded. Thus, TPC = TEC + OPC (including all contingency)

TEC is Total Estimated Cost, representing system/facility design/procurement/construction costs related to system/facility acquisition, executed with capital funds.

OPC is Other Project Costs related to engineering, development, startup, and operations. These activities/costs are essential for project execution, and are not considered a part of the normal capital system/facility acquisition costs, and are thus OPEX funded.

12.4.1 TPC Baseline and Contingency

Total project cost formulation is based on the development of the component baselines that are linked together by estimating and allocating appropriate contingency based on risk analysis.

The DOE project execution is through a Contract Budget Baseline (CBB) that represents the DOE/contractor contractual agreement for execution of the currently defined project scope of the project. Thus, while the CBB represents the project scope as presently understood/intended, the TPC includes expected project completion costs.

TPC = CBB + DOE Contingency

The DOE contingency is controlled by DOE, held outside the CBB, and transferred to the CBB as needed during project execution via documented change control. This Contingency is intended to account for evolution/changes to the project scope, and other events that occur between establishing the CBB and project completion that are beyond the control of the contractor. Simply stated, the DOE contingency should be adequate to cover all probable changes that occur during project execution. The DOE contingency should include a 3 percent to 5 percent (management decision) allowance to account for the unknown unknowns.

The CBB itself is comprised of two components:

CBB = TEC (Capital) + OPC (OPEX) (including TEC and OPC contingencies)

TPC = CBB + DOE Contingency

For both the TEC and OPC, the uncertainties related to design evolution, estimating, and changes within the contractor’s scope are addressed through establishing contingency.

TEC = TEC (base) + TEC Contingency

OPC = OPC (base) + OPC Contingency

Note that during project execution, as the TEC and OPC contingencies are utilized and become part of the TEC (base) and OPC (base), the TEC and OPC do not change. The TEC and OPC increase only when the DOE contingency is utilized through change control and transferred to the CBB.

There are two approaches to budgeting the TEC and OPC contingencies that are part of and included within the CBB:

1. Contingency is part of and included within the cost account budgets established in the Performance Measurement Baseline (PMB) for scope execution. In this case, the PMB is equal to the CBB.

2. The TEC and OPC contingencies are held outside the PMB cost account budgets and during project execution transferred to the PMB cost accounts via the change control process. Thus

PMB = TEC (base) + OPC (base)

CBB = PMB + TEC Contingency + OPC Contingency

TPC = CBB + DOE Contingency

Contingency is part of the expected costs at project completion and, therefore, must be included in the TPC established as the performance baseline. During project execution, contingency funds are transferred, via a documented change control systems, to the CBB and/or the Performance Measurement Baseline for scope execution. Tracking of the consumption of contingencies during project execution is part of the periodic review/update of the Risk Management Plan. This plan serves as the documented basis for developing and establishing project contingency used for formulating CBB and TPC baselines.

In summary, the TPC established as the project's performance baseline must include contingency. The three components of contingency are:

- TEC Contingency
- OPC Contingency
- DOE Contingency

The TEC and OPC contingencies are included in the Contract Budget Baseline. The DOE contingency is included in the TPC as part of the expected cost, but is held outside the CBB.

Several “baselines” have been discussed in this section including TPC, TEC, OPC, CBB and PMB. These “baselines” are linked to each other through the various contingency elements as discussed above. The baseline formulations presented here are intended to ensure the following:

1. Project execution and completion without an increase in the TPC. This is accomplished by establishing the DOE contingency as part of the TPC, which is totally controlled by the DOE, and initially held outside the Contract Budget Baseline.
2. Significant progress in project execution without any changes to the CBB, TEC or OPC baselines unless and until the DOE Contingency (controlled by the DOE) is utilized in the project.
3. Significant ability during project execution to address uncertainties and changes without increases to the TEC or OPC through transfer of the TEC contingency and OPC contingency to the Performance Measurement Baseline via documented change control.
4. Tracking and reporting of rate of consumption of each contingency allowance—TEC, OPC, DOE.

12.4.2 Estimating and Allocating Contingency

The risk based approach to estimating contingency to account for the cost estimating uncertainties inherent in formulating a TPC baseline utilizes Monte Carlo simulation techniques. These techniques establish an 85% to 90% underrun confidence level for the TPC (see Figure 12-1). The probability and cost distributions assigned to the Monte Carlo simulation elements must account for all the uncertainties, including the degree of scope and design definition, maturity of technology versus first-of-a-kind efforts, project cost structure and funding profile assumptions, and potential cost impacts due to scheduling uncertainties. If all these uncertainties are not captured in the Monte Carlo simulation elements, then the 85% to 90% “confidence” level is likely to provide a false and misleading sense of security. The Federal project manager is responsible for selecting the confidence level and for project completion within the resulting TPC.

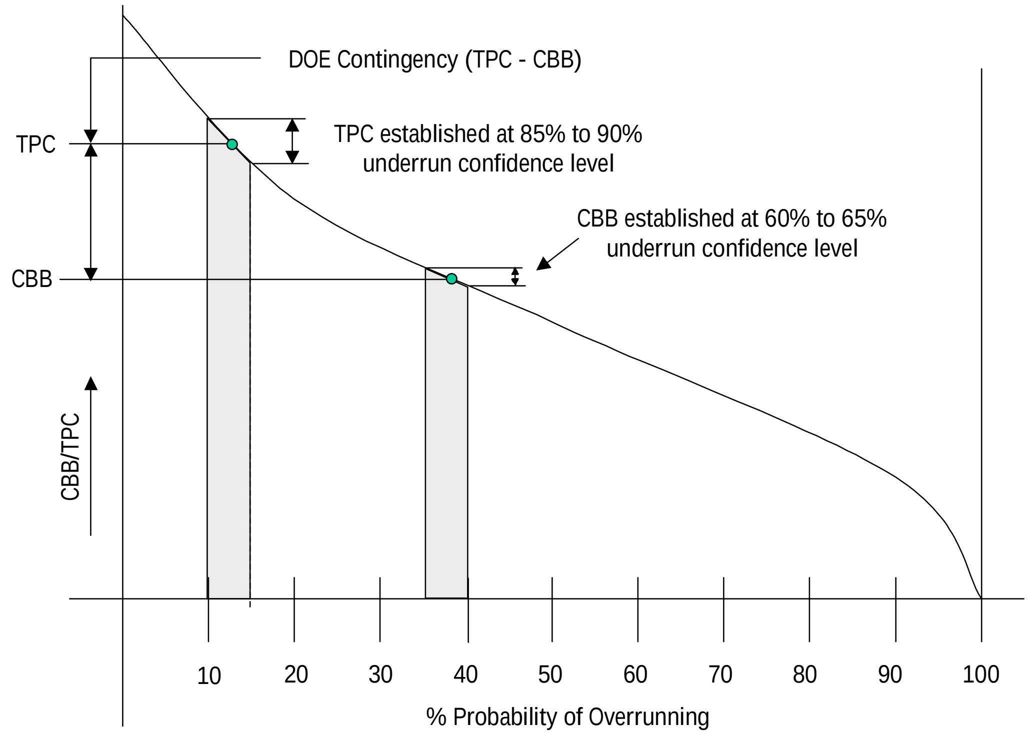


Figure 12-1. Monte Carlo Simulation: Estimating and Allocating Contingency

The "allocation" of contingency utilizing this approach establishes the project's contract budget baseline at the 60% to 65% underrun confidence level at the start of the project. During project execution, the DOE contingency is transferred to the CBB via documented change control in response to events/changes that are not within the contractor's control.

The Contractor Project Manager is responsible for execution of the defined scope within the contract budget baseline.

The assumptions used in the Monte Carlo simulation and the confidence levels used to establish the TPC and CBB baselines must be documented in the Project Execution Plan. During project execution, the risk analysis basis should be periodically reviewed and revised.

This page is intentionally blank.

13 CONTRACTING AND PROCUREMENT

Project Procurement Management includes processes required to acquire goods and services from outside the performing organization. Goods and services are called a “product.” The following are major contracting and procurement processes that are adapted from the PMI PMBOK®:

- *Procurement Planning.* Determines when and what to procure.
- *Solicitation Planning.* Documents product requirements and identifies potential sources
- *Solicitation.* Obtains quotations, bids, offers, or proposals, as appropriate.
- *Source Selection.* Chooses from among potential sellers
- *Contract Administration.* Manages the relationship with the seller
- *Contract Closeout.* Completes and settles a contract, including resolution of any open items.

These processes are interactive with each other, and with processes in other project areas. Each process can involve effort from individuals or groups based on a project need. Although the processes are discrete elements with defined interfaces, they can overlap and interact.

In a buyer-seller relationship, project contracting and procurement management is discussed from the perspective of the buyer. The buyer-seller relationship exists at many levels on any project. Depending on the application, the seller is called a contractor, a vendor, or a supplier. The seller manages his/her work as a project. The terms and conditions of a contract become a key input to many of the seller’s processes. The contract may actually contain the input (Examples: major deliverables, key milestones, or cost objectives) or the contract can limit the project team’s options; that is, the buyer’s approval of staffing decisions is often required on design projects.

This section assumes that the seller is external to the performing organization. However, most of the discussion is equally applicable to formal agreements entered into with other units of the performing organization. Practice 15, Procurement and Contracting, provides additional details about project contracting and procurement.

13.1 PROCUREMENT PLANNING

Procurement planning identifies which project needs are best met by procuring products or services outside the project organization. See Figure 13-1. It involves whether to procure, how to procure, what to procure, how much to procure, and when to procure.

Inputs	Tools & Techniques	Outputs
Scope statement Product description Procurement resources Market Conditions Other planning outputs Constaints Assumptions	Make-or-buy Expert judgement Contract type selection	Procurement management plan Statement(s) of work

Figure 13-1. Procurement Planning

When a project organization obtains products and services from outside its performing organization, the processes from solicitation-planning through contract closeout are performed once for each product or service item. When needed, the project manager seeks support from contracting and procurement specialists.

When a project organization <u>does not</u> obtain products and services outside its performing organization, the processes from solicitation planning through contract closeout are <u>not</u> performed.

Procurement planning can include consideration of potential subcontracts, particularly if the buyer wishes to exercise some degree of influence or control over subcontracting decisions.

13.2 SOLICITATION PLANNING

Solicitation planning involves preparing documents that are needed to support a solicitation. See Figure 13-2.

Inputs	Tools & Techniques	Outputs
Procurement management plan Statement(s) of work Other planning outputs	Standard forms Expert judgement	Procurement documents Evaluation criteria Statement of work updates

Figure 13-2 Solicitation Planning

13.3 SOLICITATION

Solicitation involves obtaining information (bids and proposals) from prospective sellers about how project needs can best be met. See Figure 13-3. Most of the effort in this process is expended by the prospective sellers, normally at no cost to the project.

Inputs	Tools & Techniques	Outputs
Procurement documents Qualified seller lists	Bidders conferences Advertising	Proposals

Figure 13-3. Solicitation

13.4 SOURCE SELECTION

Source selection involves the receipt of bids or proposals and the application of the evaluation criteria to select a subcontractor/vendor. See Figure 13-4. This process is seldom straightforward because

- price may be the primary determinant for an off-the-shelf item, but the lowest proposed price may <u>not</u> be the lowest cost if the seller proves unable to deliver the product in a timely manner.
- proposals are often separated into technical (approach) and commercial (price) sections, with each evaluated separately.
- multiple sources may be required for critical products.

Inputs	Tools & Techniques	Outputs
Proposals Evaluation criteria Organizational policies	Contract negotiation Weighting system Screening system Independent estimates	Contract

Figure 13-4. Source Selection

The tools and techniques described below may be used singly or in combination. Depending upon the item being procured and the method of its procurement, a weighting system can be developed and used to

- select a single source who is asked to sign a standard contract.
- rank-order all proposals to establish a negotiating sequence.

On major procurement items, this process can be iteration. In any case, regardless of which weighting systems are used, a short list of qualified sellers will be selected based on a preliminary proposal, and then a more detailed evaluation conducted based on a more detailed and comprehensive proposal. In any case, which weighting systems are used, the basis of the system must be documented along with the process and the results to assist future projects and/or claims.

13.5 CONTRACT ADMINISTRATION

Contract administration is a process of ensuring that a seller's performance meets contractual requirements. See Figure 13-5. On larger projects with multiple product and service providers, an aspect of contract administration is managing interfaces amongst the various providers. The legal nature of a contractual relationship requires that the entire project team be acutely aware of the legal implications of actions taken when administering the contract and when interfacing with the contractor.

Inputs	Tools & Techniques	Outputs
Contract Work results Change requests Seller invoices	Contract change control system Performance reporting Payment system	Correspondence Contract changes Payment requests

Figure 13-5. Contract Administration

Contract administration includes (1) the application of the appropriate project management processes to the contractual relationship(s) and (2) the integration of the outputs from these processes into the overall management of the project. When multiple sellers and multiple products are involved, this integration and coordination often occurs at multiple levels.

13.6 CONTRACT CLOSE-OUT

Contract closeout is similar to administrative closure, and involves both of the following:

- *Product Verification.* "Was work completed correctly and satisfactorily?"
- *Administrative Closeout.* Update records to reflect the final results and to archive such information for future use.

The contract terms and conditions may prescribe specific procedures for contract closeouts. Early termination of a contract is a special case of contract closeout.

This page is intentionally blank.

14 PROJECT CONTROLLING

Change control ensures that project changes are identified, evaluated, coordinated and controlled, reviewed, approved, and documented in a manner that best serves the project. Errors, problems, opportunities, new management, or the availability of new methods or tools can trigger project changes. Uncontrolled changes lead to chaos due to the far reaching effects even small changes have on a project's scope, schedule, cost, safety, risk, quality, and product.

Approved project scope, schedule, and cost baselines (Practice 7, Baseline Development and Validation) are the controlling elements for a project. Controlling changes to these baselines is an inherent element of project management that is directly related to the risks and uncertainties associated with a project.

Project changes shall be identified, controlled, and managed through a traceable, documented and dedicated change-control process. The goals of a baseline change-control process are as follows:

- To recognize and to predict changes
- To evaluate and to understand the impacts of each change
- To control consequences of changes
- To prevent unauthorized or unintended deviations from approved baselines
- To assure each change to approved baselines is evaluated, reviewed and approved at the proper level of management.

14.1 CONTROLLING BASELINE CHANGES

Baseline change control should be established early in a project's life cycle, but shall be organized and functioning prior to requesting CD-2. Thus, the project manager institutes a formal change-control process to control changes to these baselines prior to submitting a request for a CD-2. A key responsibility of each project manager is controlling changes to project baselines.

The objective of the change control process is to understand project changes. This provides better mitigation and management; the change control process in not intended to simply prevent changes. Therefore, baseline changes are managed and controlled as are other project risks: establishing a process for identifying, evaluating, and dispositioning changes.

14.2 Inputs to Change Requests

Change control framework is established in the PEP. The PEP provides the baselines against which changes are monitored and controlled. Also, baselines are compared against project performance as reported in monthly performance reports.

Once a scope (technical) baseline has been established for scope (technical) changes, engineering change requests are a method of requesting changes. However, during design, design change-requests are used for minor design errors/changes; and, during construction, field change requests are similarly used to disposition minor field errors/changes. These methods of initiating changes are monitored and approved using a tailored change control process.

14.3 Change Principles and Processes

Responsibility for change control exist at every management level, and are monitored by change-control boards (CCB boards) at those levels. However, regardless of the source or the seeming innocence of a change request, the project manager is ultimately responsible for assuring requested changes are documented, evaluated, processed, and dispositioned.

14.4 Change Control Board

Each organizational level (as appropriate and documented in the PEP) shall establish a CCB for disposition of baseline change proposals within their level of authority/control. For the Secretary of Energy, the Energy System Acquisition Advisory Board (ESAAB) acts as the CBB board. A board includes a chairperson, a secretariat, members, and advisors. The chairperson is responsible for change decisions, and is the only approval authority. Members and advisors sit on the board to advise a chairperson about technical matters involving quality; reliability; financial, schedule, and environmental, safety and health (ES&H) matters. Board meetings and decisions are documented with meeting minutes and letters-of-decisions. Procedures for establishing a board and defining the operation of a board is included in the CCB charter.

14.5 CONTROL LEVELS

Four control levels govern baseline change control for DOE projects. Agreed upon thresholds limit the control each organizational element has over baseline approval and the change-control process. **The proposed baselines and thresholds for each project shall be documented in the Project Execution Plan, and approved at the Approve Performance Baseline, the CD-2, or the equivalent decision point.** Levels and thresholds are specified in Order 413.X, Attachment 5, and are shown in Table 14-1.

Level-0 changes are for the Secretary or Acquisition Executive; Level-1, the Program Secretarial Officers; Level-2, a Federal Project Manager, as delegated by the Operations/Field Office Manager or Program Manager. Level-3 resides with the project manager.

14.5.1 Change Initiation

The initiator of a change proposal shall prepare the change request describing the change and identifying the amount of budget required or to be returned. The initiator also describes the scope of the change as well as any schedule impacts, as well as analysis of the changes.

The analysis of a change includes cost, scope, and schedule baselines, as well as: safety, quality, procurement, performance, personnel, training, other projects, other facilities, documentation, and so forth. A <u>structured approach</u> for evaluating the impacts of a proposed change is for the project manager to require that each change request be accompanied by a completed and signed preestablished project change impact checklist. This is done during project execution because of the large impact of small changes.

Each project should establish and maintain a change control log from which a unique number is assigned to each change request, and in which the title, scope and cost of the change is recorded, along with the disposition of the change and any assigned action items. If the change impacts project contingency, then entries must also appear in the project contingency log.

Often, a project change is initiated by Congressional action, such as an appropriation act that reduces funding. In such cases, the project manager would prepare a project change request and submit it through normal channels for review and approval. The change must be documented and approved by the appropriate SAE/AE within 3 months from when the Congressional action occurs.

Table 14-1. Baseline Change Control Approval Thresholds

Approval Authority

Level 0 Changes - Secretarial Acquisition Executive
Level 1 Changes - Program Secretarial Officer
Level 2 Changes - Federal Project Manager as delegated by the Operations/Field Office Manager or Program Manager
Level 3 Changes - Contractor

2.a Major System Projects

Major System	Level-0	Level-1	Level-2/3
Technical Scope	Changes to scope that affect mission need requirements.	Changes to scope that may affect operation functions functions, but does not affect mission need.	As defined in the Project Execution Plan.
Schedule	Six or more months increase (cumulative) in a project-level schedule milestone date.	Three to six months increase (cumulative) in a project-level schedule milestone date.	As defined in the Project Execution Plan.
Cost	Any increase in Total Project Cost and/or Increase in Total Estimated Cost.**	Project cost sub-elements as defined in the Project Execution Plan.	As defined in the Project Execution Plan.

2.b Other Projects

Other Projects*	Level-1	Level-2/3
Technical Scope	Changes to scope that affect mission need requirements.	As defined in the Project Execution Plan.
Schedule	Six or more months increase (cumulative) in a project-level schedule milestone date.	As defined in the Project Execution Plan.
Cost	Any increase in Total Project Cost and/or increase in Total Estimated cost.**	As defined in the Project Execution Plan.

* For Other Projects less than $100M, the PSO may delegate Level-1 approval authority to the Program Manager or operations/field office manager. General plant projects, accelerator improvement projects, capital equipment projects, and operating expense funded projects that are $5M or less are the responsibility of the Federal Project Manager as delegated by the Operations/Field Officer Manager.

** Total Estimated Cost does not apply to environmental restoration projects.

15 PERFORMANCE MANAGEMENT

Performance management covers techniques used by the Federal project manager and staff to measure, grade and, as appropriate, reward contractor performance. The level of control or oversight and contract type are the drivers for determining the type and complexity of the process used for measurement and level of implementation. In all cases, the measurement process should be cost-effective and represent a contractual requirement between DOE and the contractor.

The three most-often applied performance management techniques within DOE are earned value, award fee, and performance indicators. While these methods of measurement and their application are described, there are other performance management techniques; for example, cost-sharing incentives. The type of contract and project should dictate the most appropriate technique applied.

15.1 PERFORMANCE MEASUREMENT

Measuring and reporting project performance on a scheduled basis is a key project management responsibility during project execution. This process (1) demonstrates progress toward accomplishing goals and objectives, and (2) helps project management do the following:

- assess the results of activities compared with planned goals
- determine progress toward achieving the projects' mission
- improve performance at all organizational levels

Each DOE project shall develop and implement a comprehensive, yet tailored, performance measurement/earned value system.

Performance measurement

- provides the basis for making informed management decisions.
- keeps responsible organizations and stakeholders apprised of successes, problems, progress, and results.
- provides a common link between planning, budgeting, execution, and evaluation.
- provides a basis for establishing accountability (*Integrated Planning, Accountability, and Budgeting System Handbook*, IPABS, February 16, 1999).

For any performance measurement systems to be effective it must be supported by an Earned Value Management system (EVMS). **In addition, as appropriate, the application of performance measurement/earned value shall be imposed on project suppliers, vendors, manufacturers, and support organizations.**

15.1.1 Award Fee

An award fee within DOE rewards a contractor with an additional fee for performing certain identified tasks. This process is used with Management and Operating (M&O) contractors to obtain a higher level of performance tasks associated with an incentive. The process is (1) contractual with an agreement on the total award amount of earned fee, (2) spread over various aspects of the contracted work. Award fee is often used to <u>strengthen</u> and direct management attention to an underperforming area. The DOE and the contractor create a written agreement describing the desired tasks the contractor is to accomplish and the associated award fee.

The process has merits as well as shortcomings. While award fee often focuses management emphasis on specific tasks, the “shift in attention” was often achieved at the expense of performance in other areas. In addition, the appraisal process was cumbersome, generally subjective, and subject to dispute. As the Department increases Management and Integration (M&I) contracting, the award fee process is used less frequently.

15.1.2 Performance-Based Contract Incentives

The Government Performance and Results Act (GPRA) of 1993 requires Federal organizations to develop formal plans and goals for measuring performance. A long-range strategic plan forming the basis for performance measurement is required at the Federal Agency level (DOE) and flows to the PSO and the operations or field office, which are required to annually report progress toward the goal.

To meet the growing emphasis on performance-based management, delivery of results, and accountability for achieving results, DOE has moved toward a greater use of Performance-Based Contract Incentives (PBCI). The contract incentives are performance measures/indicators that place incentives on the attainment of baseline schedule elements, physical accomplishment, and management performance by the contractor. These incentives are promulgated to the contractor in terms of performance regarding objectives, measures, and expectations.

There is a top-down correlation at all levels of performance between DOE's desired outcome, what is being done to meet it, and how well it is being done. For the M&I contractor, performance indicators and their values are negotiated and become contractual. They are then used by the DOE to measure: (1) contractor accomplishments and (2) the level of quality-incentive fee payment or, conversely, loss of incentive fee.

15.1.3 Traditional Performance Reviews

All the methods for ascertaining performance is no substitute for a standup, face-to-face presentation that provides a forum for determining progress/performance. **For all projects, the appropriate AE shall conduct a quarterly project performance review with the Federal Project Manager and staff.**

The contractor may participate in this review as appropriate. For MS projects, the schedule and agenda are coordinated with OECM; the OECM is invited to participate with the PSO in the review. Quarterly performance reviews for Other Projects with TPCs less than $100M may be delegated to a Program Manager or Operations/Field Office Manager. The contractor may participate in this review as appropriate. The OECM is invited to all performance reviews for projects with a TPC over $5M.

This review takes many forms. Generally it is a Federal project manager/contractor project manager verbal and visual presentation of a current program/project condition. Such reviews do not replace the contracted fee incentive process, but are an adjunct that provides timely information in an open forum. The performance review is scheduled on a consistent periodic interval to help ensure the attendance of all affected parties, and to award the possibility of long periods of time between reviews. These reviews, conducted in the proper interface mode, increase teaming between the DOE and contractor staff.

15.2 Earned Value Management System

Contracts with project TPCs of $20M or more (except as noted in 15.2.1) must be Earned Value Management System (EVMS).

An Earned Value Management System (DOE Order 413.X, Attachment 3) for project management will assist in effectively integrating a project's work scope with schedule and cost elements. The primary purpose of the EVMS system is to support management. (*Earned Value Management Systems, EIA Standard* ANSI/

EIA—748-1998, May 19, 1998) and PMI PMBOK®, Section 10.3, Performance Reporting. The basic input to an EVMS are to:

- identify the project's total work scope and correlate it with the project WBS.
- plan all work scope that the project must complete.
- integrate work scope, schedule, and cost into a baseline plan at the work control level against which performance (accomplishments) can be measured.
- objectively assess accomplishments at the work performance (work package) level.
- analyze significant variances from the plan and forecast the impacts.
- provide data to higher levels of management for decisions and implementation of corrective actions.

The essence of earned value management is that at some level of detail appropriate for the degree of technical, schedule, and cost risk or uncertainty associated with the project, a target value (for example, budget) is established for each scheduled element of work. As these works are completed, their target values are "earned." As such, work progress is quantified and earned value becomes a metric against which to measure: a) the funds spent to perform the work and, b) the work scheduled to have been accomplished.

Schedule variances not seen in a standalone budget versus actual cost tracking system, are isolated and quantified. Therefore cost variances are true cost variances not distorted by schedule performance. This gives early awareness of performance trends, variances from baselines, and allows management to make decisions while there is time to implement corrective actions. Without earned value, a manager can only compare planned expenditures with actual expenditures. This comparison, however, does not provide an objective indication of the planned work was accomplished.

For earned value benefits to be realized, planning along with the establishment and main- tenance of a baseline for performance measurement are necessary. Advance planning, baseline maintenance, and earned value analysis yield earlier and better visibility of project performance than that of nonintegrated methods of planning and control.

15.2.1 EVMS Guidelines

For projects less than $20M, implementation of an EVMS is not required. Additionally, it is not required on some contracts such as:

- time and materials
- firm, fixed-price
- level-of-effort support contracts

However, these contracts and contractors shall also have adequate control systems that suit the nature of the effort and reflect good business practices.

15.4 PROJECT MANAGEMENT METRICS

Project management metrics and earned value are similar yet different. They are similar in that both are used to evaluate/measure project progress and performance. They are different in that earned value is the total budgeted value of that portion of the scheduled work that actually accomplished (BCWP). Earned value is thus related to the detailed project schedule and cost estimate, and a well-defined work scope. Performance metrics, on the other hand, are measures of physical progress, such as the following:

- Material quantities to be processed: mass, volume, number of containers, handling units
- Documents delivered: SAR, Project Execution Plan, Seismic Study
- Products delivered: yards of concrete placed, tons of rebar installed.

15.4.1 Measuring for Results

Systematic measurement of baseline performance shall be conducted for each project in order to facilitate timely, meaningful, and proactive monitoring. The performance measurement activity monitors the quality and utility of technical, schedule, and cost baselines. This program recognizes that the primary goal is better management and informed decision-making, not just measurement.

In developing metrics to assess performance against baselines, consideration should be given to ensuring the following:

1. All baselines are linked to the WBS.
2. Scope is defined for all baseline elements.
3. Schedule and cost baselines are traceable and linked to the scope baseline
4. The technical baseline is traceable and linked to the project mission.
5. The level of baseline detail should be commensurate with the project phase and appropriate tailoring.

Metrics focus on output and the achievement of overall output goals (as opposed to input or process) and avoid micro-management.

The following Four-step process is used in a performance measurement program:

Step One. Planning (identifying and defining the metrics)

Step Two. Measuring achievement/progress/performance

Step Three. Comparing performance to goals

Step Four. Identifying corrective actions for poor performance.

As a project progresses from initiation through execution, performance measurement criteria shall be periodically reviewed and updated. Metrics or criteria not being met are reviewed to determine the reason(s) for the variance(s) and to identify corrective action(s), whether it be revisions to the metrics or project work-arounds. This review should involve all project team members and should also help identify problems and potential problems.

Metrics are a “broad” level measurement while earned value is directly linked with project schedules, costs, milestones, and scopes of work. If desired, metrics become earned-value items by linking them directly to cost and schedule baselines.

15.4.2 Contract Milestones

The DOE expects a relationship between performance measure and key DOE and EM planning and reporting documents (see EM FY 2000 Limited Update Budget Guidance from EM-20, October 1, 1998). From both Congress and the OMB, the DOE has requirements to track volumes of waste (or other measures) and to report them at least annually.

Two typical metrics/performance indicators include the following:

Milestone Reporting. All project milestones are statused on a monthly basis, identifying: (a) scheduled completion dates, (b) actual completion dates, and (c) forecast completion dates for milestones expected to be different from those scheduled.

Technical Progress Indicators. Certain product or production-oriented parameters are evaluated/measured periodically and compared to time-phased plans for measuring schedule performance. Examples of such indicators include gallons of waste processed, number of drums produced, tons of soil removed, or cubic yards of concrete placed.

Whereas these indicators are an accurate measurement of schedule performance, they do not provide direct measurement of cost performance. However, the progress-to-date and forecast schedule completion dates are useful. For example, waste stream data is periodically provided at a customer's request and used along with similar information from other DOE sites for quarterly tracking of national cleanup information.

Regardless of the EVMS implemented on a project, each project shall (on a tailored basis) prepare a list of metrics that can be used to gauge project progress on an overall basis. These metrics prove most useful if the progress of tracked item is provided in graphical form (pie chart; bar chart). Use of metrics is useful in evaluating subcontractor performance. Typically, metrics are identified in a subcontract so no misunderstandings exist about what is desired and expected of the subcontractor.

In-house support performance is gauged using metrics. For example, the review times required for design review packages, types and number of review comments, number of surveillances performed, number of vendor audits performed, number of welds radiographed, and so forth.

Safety is important where metrics are used to measure company, organization, project, or subcontractor performance. Typical examples include lost-time accidents, reported injuries, attendance at safety meetings, contamination incidents, radiation exposures, and so forth. In this case, project performance is compared to company performance, DOE performance, industry performance, and past-period performance. In the case of safety graphs and curves, a secondary use is projecting future performance and identifying needed training.

This page is intentionally blank.

16 PROJECT RESOURCE MANAGEMENT

Each DOE project has both a Federal project manager and a contractor project manager.

To be effective, a project must be performed by motivated, qualified, and diversified individuals. Both the project management and the project team—this is not the Integrated Project Team—are totally dedicated to the project.

To ensure that project personnel emphasize project planning, and work towards successful project completion, roles and responsibilities should be clearly defined; individuals with appropriate capabilities and experience selected; appropriate training provided to develop or enhance under-represented capabilities or skills, and proactive communication established.

Project human-resource management includes the processes required to ensure effective use of project personnel. It includes all the project stakeholders: sponsors, customers, individual contributors, and others as appropriate. Specific activities that comprise human resource management include the following:

Organizational planning that identifies, documents and assigns project roles, responsibilities, and reporting relationships.

Staff acquisition that obtains necessary human resources, assigns resources to the project, and assigns work to project personnel.

Team development that develops individual and group skills to enhance project performance and provides opportunities for advancement and promotion.

Although the processes are often presented as discrete elements with well-defined interfaces, they can develop and interact in many ways. A project manager should select and develop the project team in areas/skills that can include

- leading, communicating, and negotiating.
- delegating, motivating, coaching, mentoring, and so forth that relates to interfacing among individuals.
- team building, dealing with conflict, and so forth that relates to interfacing among groups.

- performance appraisal, recruitment, retention, labor relations, health and safety regulations, and other subjects related to administering the human resource function.

16.1 Roles and Responsibilities

The nature of projects and project processes makes everyone both a customer and a supplier. Therefore, each person involved must have a clear understanding of his/her roles and responsibilities. Projects are often divided into discrete work tasks (subprojects) with a responsible project individual assigned to manage a portion of the total project. **Early in the project life-cycle, the project manager shall prepare a responsibility/authority matrix that identifies a responsible individual for each project work task.** The individuals involved should understand and concur with their assignment of responsibility, authority, and accountability and be aware of similar assignments among the project team.

Organizational planning involves identifying, documenting, and assigning project roles, responsibilities, and reporting relationships. Roles, responsibilities, and reporting relationships are assigned to individuals or to groups. The individuals and groups may be internal or external to the organization performing the project. The linkage between the organization and the Work Breakdown Structure (WBS) is the Organizational Breakdown Structure (OBS).

The majority of organizational planning is done during the earliest project phases. However, the results of this process are reviewed regularly throughout the project to ensure continued applicability. Since different skill-mixes are frequently required, this review is particularly important during project execution.

16.1.1 Project Manager

A project manager (Federal project manager or contractor project manager) is the individual responsible for accomplishing a designated unit of work or group of closely related efforts to achieve a designated objective within a certain time frame. The project manager is responsible for assuring that project goals and objectives are met—quality work is on time and within budget—and for making appropriate management decisions on the project.

A number of different organizations and individuals are orchestrated by the project manager into a team effort that ensures project goals and objectives are met. The project manager is the primary contact for all response actions, and as such coordinates, directs, and reviews the work of all individuals involved.

Each Federal project manager shall prepare formal Memoranda of Understanding with management, user and contractor project manager(s) as early as possible, but prior to requesting CD-2. These memoranda of understanding may be in the PEP and should clearly identify the responsibilities and authorities of each organization associated with the project to avoid misunderstandings and confusion. **Each memoranda shall be timed, dated and signed by each involved individual.**

A project manager shall prepare and issue a project charter which defines the project and the job descriptions for all team members. This document helps identify and clarify roles, responsibilities, and authorities.

16.1.2 The Integrated Project Team

An Integrated Project Team (IPT) is organized and led by a Federal project manager. The IPT includes a number of DOE functional areas, such as budget, financial, legal, safety, and contracting. The IPT has a responsibility in the performance of a project and remains organized and functioning throughout the life-cycle of a project. The earliest responsibility of the IPT is to assist the Federal project manager in developing an acquisition strategy, and in preparing and issuing an Acquisition Plan. As a project progresses from the preconceptual to the operation, the members of the IPT can change during the life-cycle of the project to reflect changing project activities. As a result, the IPT eventually includes operators, engineers, scientists, legal personnel, and a contracting officer. The IPT members include both DOE and contractor employees.

Selection of the project team is a crucial project manager responsibility. Team members must be educated, trained, and skilled. They should be self-starters, able to work with minimum supervision; possess excellent communication skills; and able to function as a team member. As the primary contact for project activities, the project manager is in the best position to know what strengths the project team needs. Early team organization enhances future success by establishing early group communication and a sense of ownership of the project. Organization of the team varies by project, but generally the members fall within FOUR categories: the core team, the base support team, the decision-makers, and outside agencies. The project manager exerts as much control over the makeup of the team as possible.

The project manager determines what expertise is needed in a core project team. For example, the expertise required for an environmental restoration project might consist of environmental assessment, health and safety, biological sampling, water/wastewater sampling, soil sampling, air sampling, engineering experts (environmental, civil, safety, and mechanical), public affair/community relations coordination, legal, planning commission (local planning and design), industrial hygiene, construction contractor with engineering oversight, and various technical experts for review committees.

As a project team starts to function, backup or replacement members are identified and trained, particularly for critical activities. Assuring project continuity is important. Backup personnel are members of the project team. The "backup philosophy" especially applies to the project manager.

16.2 Customer Interface

For DOE projects, the DOE is the ultimate "customer" for the project products. However, the DOE generally assigns or contracts responsibility for operating and maintaining facilities to contractors (M&O/M&I). Thus, the term "user" in this discussion refers to the entity that operates and maintains the completed facility. The user is the entity that owns, operates, uses, or benefits from the product of the project, and thus must be a member of the core project team. The user provides an initial description of the project purpose and objective; the project manager makes the user aware of their responsibilities for the project. For example, as early as possible, the project manager should inform the user that failure is possible if the project cannot be clearly defined and scoped early in the process.

Changes by the user/customer can result in schedule delays and cost overruns. Continuous and intensive communication between the user/customer and the project team should occur during the project definition stage. This is crucial to the development of the Project Execution Plan and to the successful completion of the project in accordance with that plan. The customer is primarily concerned with quality and function and relies on the project manager and the project team for project direction and decisions, schedule and cost information.

16.3 Staffing Management Plan

The staffing management plan describes when and how human resources are added to and removed from the project. Based on the needs of the project, the staffing plan is a subsidiary element of the overall Project Execution Plan (PEP), and may be formal or informal, highly detailed or broadly framed. The staffing management plan includes resource histograms.

Project managers should give particular attention to how project team members (individuals/groups) are released when no longer needed on the project. An appropriate reassignment policy and effort may be as follows:

- Reduce costs by minimizing or eliminating the tendency to "make work" to fill the time between an individual's present assignment and the next assignment
- Improve morale by reducing or eliminating uncertainty about future employment opportunities.

16.4 Organization Chart

An organization chart is a graphic display of project reporting relationships. This chart may be formal or informal, highly detailed, or broadly framed, based on the needs of the project. For example, the organization chart for a three-to-four person internal-service project is unlikely to have the rigor and detail of an organization chart for a 3,000-person, nuclear power plant outage.

An organizational chart should be created for each DOE project showing the responsible and accountable person for each required functional area. Customer/user interfaces should also be reflected in this chart.

An OBS is a specific chart that showing which organizational units are responsible for which work items. A project OBS should integrate with the WBS and the baseline cost estimate.

16.5 TRAINING

16.5.1 Program/Project Management Career Development Program (PMCDP)

The Deputy Secretary of Energy has endorsed the development of the Program/ Project Management Career Development Program in response to several recommendations from the National Research Council (NRC) report on DOE project management. The NRC report recommended that DOE:

- Establish a department-wide training program for project managers
- Establish criteria and standards for selecting and assigning project managers
- Require all project managers to be trained and certified.

The end product of the effort to develop a DOE PMCDP will be a multi-level certification process, wherein DOE Federal project managers will be required to be certified. The specific certification provisions/processes, including "grandfathering" of existing project managers, will be developed by the task force.

16.5.2 Project Personnel Training

Once project team members have been selected, the project manager should ensure each individual has (or receives) the training necessary to complete the assigned project tasks. Project managers are expected to utilize existing training programs when possible. During project definition, the project manager needs to factor training into the project scheduling and cost estimating efforts. Assessing project personnel training needs involves three steps:

- Evaluating the job functions of all project personnel
- Developing essential and supplemental core competency requirements for the project manager and other key project personnel based upon the multidisciplinary nature of the project
- Identifying and evaluating current project management, project definition, and process-specific training offered by DOE, contractors, regulatory agencies, and others.

When properly developed and implemented, training is a project-specific program that, ensures that project participants have the knowledge and skills to effectively perform assigned tasks. Training includes general project indoctrination, classroom, on-the-job (performance-based), simulator exercises, reading, conferences, and workshops.

Training subject matter should include project mission, project baselines, project procedures, engineering and management processes, communication and approval channels, identification and management of project interfaces, and definition of the end product. The training organization uses the project mission as a basis in preparing training materials and conducting training. A particularly important portion of each project's training program should be training of project personnel (and later operations and maintenance personnel) in policies and procedures. This training assures that all involved personnel are aware of the required methods of performing projects, and operating and maintaining completed facilities.

Generation of the training program begins with a training organization working with the project to gather information and prepare a training plan that identifies training needs. This effort evaluates project needs, organizational plans, and required employee qualifications. The project team participates in all phases of the training process. The training organization generates the training program in accordance with the training plan. Training materials are commensurate with the need to train personnel in new skills; maintain existing skills; and cover technologies, tools, methods, and procedures.

An external interface exists with the training program for the operations and maintenance phase. Interfaces may also exist in the form of conferences, workshops, and symposia, which may significantly enrich training programs with discussions on state-of-the-art training and technical systems. The training organization seeks these interfaces and promotes their use within the project organization. The training organization also maintains a continuous interface with the project manager to assure project needs are being met.

The training organization should update training materials as needed and maintain them in an accessible repository. Also, the training organization should develop and maintain training records and ensure that they are (and remain) current. Certificates, licenses, and other documentation associated with formal training is tracked and maintained in a training file or database. A means to track and improve one's training and qualifications is to create development plans for each team member.

The project manager periodically reassesses training effectiveness and initiates actions to correct deficiencies and provide improvements.

16.6 PROJECT TRANSITION

As a project proceeds from execution to checkout and turnover to the user, a project manager assures that the unique capabilities, skills, and knowledge of a project team are not "lost" to the user organization. Activities that the project manager should implement during this process include:

- Assuring that a user both witnesses and participates in component and systems testing. This activity initiates operations and maintenance personnel training in (1) facility layout, (2) equipment design requirements, (3) equipment location, and (4) system and equipment operation and maintenance.
- Planning and providing (or participate in providing) on-the-job and classroom training for user personnel. This assures that the knowledge and experience gained by a project team is not lost over the life of the project, but is passed-on; and user personnel obtain facility knowledge before a project team is reassigned.

17 REPORTING AND INFORMATION MANAGEMENT

Project information management is inseparable from project documentation and data management process. It provides critical links among people, ideas and information necessary for success. Everyone in a project must send and receive communications in the project "language." They must also understand how information or documentation sent or received affects the project as a whole. Information management includes processes required to ensure timely and appropriate generation, collection, dissemination, storage, and ultimate disposition of project information.

Early in a project's life cycle the task of managing documentation is easier. The project participants are usually small and document management is simply controlling the revising and the distributing of project documents. As the project progresses, document management expands exponentially and the task of managing information becomes complex. The increased volume of information, number of documents, number of participants, and number of requests for changes "all" contribute to project complexity. The task of managing this information is a challenge, and it is essential to project success.

Key processes to effective information management include the following:

Identification. Selects components that require control and selects documents that define the project and components.

Document Control. Receives, identifies, stores, controls, reproduces, tracks, retrieves, and distributes documents.

Change Control. Provides a method for managing project changes to ensure that changes are properly identified, evaluated, reviewed, and if approved, implemented, tested, and documented.

Data Management. Ensures that project information and project end-product(s) are recorded and disseminated.

These processes interact with each other and with other project processes and may overlap. Based on the needs of the project, each process involves efforts from one or more individuals or groups of individuals. Each process occurs continuously throughout the project's life cycle.

17.1 COMMUNICATIONS PLANNING

The management skill of communicating is related to, but not the same as, project communications management. Communicating is a broader subject and involves a substantial body of knowledge not unique to a project.

Communications planning determines the information and communications needs of stakeholders: who needs what information; when they need it; and how is it provided to them. While projects need to communicate project information, the methods of distributing information vary widely. Identifying the information needs of stakeholders and determining a means of meeting them are important for project success.

Since a project's organizational structure has a major effect on a project's communications requirements, communications planning is linked with organizational planning.

Communications requirements are the sum of the information requirements of the project stakeholders (including project personnel). Requirements combine the type and format of information required with an analysis of that information's value. Project resources are expended on communication contributing to success or where communication can lead to failure. Information required to determine project communications requirements includes the following subjects and inquiries:

- Project organization and stakeholder responsibility relationships
- Disciplines, departments and specialties involved in the project
- Logistics of how many individuals are involved with the project and at what locations
- External information needs; for example, communicating with the media.

The technologies or methods used to transfer information among project elements should be selected based on the following:

- *The immediacy of the need for information*—is a project's success dependent upon having frequently updated information available on a moment's notice or would regularly issued written reports suffice?
- *The availability of technology*—are the systems already in place appropriate or do project needs warrant change?

- *The expected project staffing*—are the communications systems proposed compatible with the experience and expertise of the project participants or will extensive training and learning be required?

- *The length of the project*—is available technology likely to change before the project is completed and in a manner that would warrant adopting a newer technology?

- *Stakeholder needs*—The information needs of the various stakeholders should be analyzed to develop a methodical and logical view of their information needs and sources to meet those needs. The analysis considers methods and technologies suited to the project that provide the information needed.

The project should develop a tailored communications management plan that provides the following:

- A collection and filing structure that details what methods are used to gather and store various types of information. Procedures should cover collecting and disseminating updates and corrections to previously distributed material.

- A distribution structure that details
  - to whom information will flow; information types, such as status reports, data, schedule, technical documentation, and so forth.
  - what methods are used to distribute various types of information; methods such as written reports, meetings.

  This structure must be compatible with the responsibilities and reporting relationships described by the project organization chart.

- A description of the information to be distributed including format, content, level of detail, and conventions/definitions to be used

- Production schedules showing when each type of communication will be produced

- Methods for accessing information between scheduled communications

- A method for updating and refining the communications management plan as the project progresses and develops.

A communications management plan may be formal or informal and highly detailed or broadly framed. The plan should be based on the needs of the project and is a subsidiary element of the overall PEP.

17.2 Information Distribution

Information distribution makes information available to project stakeholders. It includes implementing the communications management plan as well as responding to unexpected requests for information.

Communications skills exchange information. A sender's information is to be clear and complete so that it is received correctly and confirmed. The receiver makes sure that information is received in its entirety and understood correctly. Communicating has many dimensions, as follows:

- Written and oral, listening and speaking
- Internal (within a project) and external (to a customer, the media, the public, etc.
- Formal (reports, briefings ...) and informal (memos, ad hoc conversations . . .)
- Vertically up-and-down the organization and horizontally with peers

Information is shared by teams through a variety of methods, including manual filing systems, electronic text databases, project management software, and systems allowing access to technical documentation, such as engineering drawings.

Project information is distributed using methods such as project meetings, hard copy document distribution, shared access to networked electronic databases, fax, electronic mail, voice mail, and video conferencing. The project manager assures a "rumor mill" will not become the project's informal method of information exchange.

Project records include correspondence, memos, reports, and documents describing a project. This information should be maintained and organized. Project team members may maintain personal records in a project notebook. The project manager must assure, however, that project records are not maintained, held or controlled by project personnel. That is the function of document control.

17.3 Reporting

Using the data elements, analyses, and other information specified in this manual, the Federal project manager submits monthly and/or quarterly project status reports to line management, the project management support office, and the

OECM. Internal project reporting typically begins during CD-0 with (1) a comparison of contractor performance with the conceptual design schedule and cost plan, and (2) a comparison of earned value performance against the preliminary baseline range at CD-1. External reporting to OMB is initiated at CD-2 with a comparison of earned value performance with the performance baseline. The program manager and Federal project manager defines the specific reporting requirements in the appropriate project documentation. At a minimum, such reports for projects with a TPC greater than $20M include the Earned Value Management System performance and financial status.

A DOE project management reporting system is used for tracking project performance and corrective actions. Trending data is established by OECM for cost, schedule, scope, and timely resolution of corrective actions.

Each project is responsible for preparing required reports on a tailored basis. All reports are thoroughly reviewed and approved by the responsible cost account managers and the project manager prior to release. Typical project reports are described in the following subsections.

17.3.1 Progress Report

Based upon an agreed frequency, a project provides a monthly and/or quarterly project status report(s) that includes all costs, activities and progress, through the last working day of the previous reporting period. The report is provided to the customer soon following the end of the previous reporting period, before the tenth working day of the following period. The format and content of the project's status report is established by agreement with the customer and is consistent from reporting period to reporting period. Each report is comprehensive and self-explanatory such that a reader can grasp and understand the status of project activities, especially those concerning established baselines: scope, schedule, and cost.

Specifically, a project's status report should include

- a narrative of accomplishments and activity status, and the project manager's assessment of the overall project, including each major project activity; for example, subcontracts and procurements.
- cost performance curves for the entire project and each major activity. These curves provide cumulative and fiscal year-to-date BCWS, BCWP, and ACWP.
- earned value reports; cost, funding and budget data; a revised estimate to complete (EAC); reserve transactions, milestone status, and labor figures.

- technical performance analysis report, and corrective action plan for variances to a project's technical baseline as defined in the PEP.
- schedule and cost variance analyses and corrective action plans that integrate scope, schedule and cost performance, if cumulative or if at-completion variances exceed established thresholds as defined in the PEP.
- analysis of schedule and cost performance, and projections of future performance.
- identification or forecast of potential problems.
- analysis of financial status.
- baseline change history at baseline control Levels 0 and 1, and impact of approved changes on project contingency.
- summary of schedule, schedule and cost performance, financial and critical decision issues.
- identification of new and closed action items and current status of open action items.
- for each high-level WBS element, a description of the scope and status of work being performed in that element.

A status report provides a customer and management with detailed, current project status information to support program and project decisions; and, if necessary, identify and implement corrective actions.

17.3.2 Financial Report

A financial report provides a spending variance as measured against the Financial Plan. This report displays current and cumulative cost status of both DOE funding and other funding sources; reports variances at the contract level; and projects future planning for the remainder of the fiscal year. The contents of this report are by agreement with the DOE.

17.3.3 Labor Summary

A labor summary report (if required) provides a fiscal year chart and tabular summary of project labor budgeted and actual head-counts planned for each reporting period.

17.3.4 Cumulative Summary

A cumulative summary report provides a graphic and tabular representation of percent budgeted, performed, and spent each period for Levels I, II, and III of the WBS. Data is cumulative from the beginning of the fiscal year.

A cumulative performance curve illustrates cumulative BCWS, BCWP, and ACWP on a periodic basis at Levels I and II of the WBS, while a tabular summary provides numerical data as well as schedule and cost variances.

17.3.5 Project Manager's Quarterly Progress Report

At DOE direction, a quarterly progress report is prepared for the DOE Program Office. This report provides performance data, financial data, schedule and milestones status, and a narrative assessment of the project's current status. In addition, this report provides earned-value data, project contingency transactions, and the status of project milestones.

17.3.6 Status Reviews

Projects prepare and provide project status reviews for the DOE and contractor management. These reviews provide both information exchanges and information more detailed than that provided in status reports.

These reviews provide opportunities to provide more specific and detailed project information than possible in a structured, formal status report. These meetings provide opportunities to respond to questions or concerns, discuss future actions and activities, identify needed user or contractor support, and discuss actions or decisions by external entities influencing the Project; for example, OMB, EPA, Congress, DNFSB. Finally, these meetings are a forum for identifying, discussing, and resolving issues (or assigning actions) before they become a problem and previously assigned actions become closed.

17.3.7 Other

Additional reporting requirements, if any, shall be determined by the DOE Federal project manager and the responsible DOE program office. Agreements will be documented in the Project Execution Plan.

The project manager shall submit quarterly project status reports using the data elements, analyses and narrative information specified above. The report should include an assessment of project status by the DOE project staff.

DOE program managers shall provide project status reports to the Acquisition Executive on a quarterly basis, including their assessment of project performance as required by the Acquisition Executive.

Project status is reported to the Office of Management and Budget as stated in the Chief Financial Officer's Budget Formulation Handbook.

17.4 ADMINISTRATIVE CLOSURE

After either achieving its objectives or being terminated for other reasons, a project requires closure. Administrative closure verifies and documents project results to formalize acceptance of a product or project acceptance by a sponsor, client, or user. It includes project records (ensuring they reflect final specifications), analysis of project success and effectiveness, and archiving such information for future use.

Administrative closure activities are not delayed until project completion. Each phase of the project is properly closed to ensure that important and useful information is not lost.

All documentation that records and analyzes project performance, including planning documents that establish framework for performance measurement, must be available for review during administrative closure. This includes appropriate project records that aid understanding project initiation, performance, scope, schedule, and cost.

Documents that describe the product of the project (plans, specifications, technical reports/studies, drawings, electronic files, etc.) must also be available for review during administrative closure.

A set of indexed project records is prepared for archiving by the project. Any project-specific or program-wide historical databases pertinent to the project is updated. **When projects are performed under contract or when they involve significant procurement activity, particular attention must be given to archiving financial records.**

Documentation stating that a client/sponsor/user accepts the product of a project is prepared, signed, and distributed.

18 TRANSITION AND TURNOVER

A planned, structured, and organized project transition and turnover is essential for the success of any project. Transition and turnover is (1) the progression of a system or facility from a project mode to an operation and maintenance mode or (2) the completion of a remedial action including packaging and disposal of all waste.

Planning for the transitioning of a project to a user is an integral part of project planning and performance activities from the planning phase of a project. Planning for this activity includes the identification of funds to perform the required activities. Without proper planning, preparation, and adequate funding, an activity can become unsatisfactory.

Although turnover of a completed facility is preferred, because of the phased nature of construction projects, partial transfers/turnovers can become necessary. Turnovers are acceptable if cost-effective and beneficial to the DOE. These turnovers are equipment items, operating systems, or facility areas. A properly planned and implemented project transition and turnover develops ownership within the user organization and serves to transfer ownership from project to user.

18.1 CHECKOUT AND TESTING

Early physical activities of transition and turnover include (1) facility walk-downs for identification of deficiencies, and (2) planning, preparation, performance, documentation of equipment, and systems testing and operation. These activities are identified by several titles; as example, component testing and system testing can be used.

18.1.1 Checkout

Equipment, systems, and facility checkouts/walk-downs are an effort by the construction entity and the project organization. However, the project manager performs walk-downs and completes corrective actions (punch lists). Walk-downs occur by constructor notification that a construction is complete. The bases for walk-downs is to approve design and construction documents. Walk-downs are performed by (1) establishing combined project/construction/user teams that review and inspect areas or systems as they are declared complete by the construction contractor and (2) comparing the "completed product" against approved requirements. A team documents discrepancies and deficiencies using a punch list(s); identifies a corrective action; assigns a responsible individual for each deficiency; and identifies a corrective action completion date. Deficient items are tracked to completion and then are reinspected and retested for acceptability. The walk-down activity serves as a basis for the customer accepting a completed project.

An especially important, yet separate walk-down, is the safety walk-down. This walk-down is performed by qualified project/user/safety personnel immediately prior to facility transition. A safety walk-down identifies any facility, system, or equipment safety deficiencies that might still exist. A safety walk-down team is instructed concerning the purpose of the walk-down and should be totally focused on safety and nothing else.

18.1.2 Testing

The purpose of testing is to assure technical performance. **The project manager shall prepare or have prepared component and system test procedures, perform or witness the tests, document the test results, and complete or have completed all required corrective actions.** Test teams should be organized to prepare test plans, perform all test activities and evaluate test results. The test teams should include project and user personnel. Testing serves two valuable purposes: (1) to verify that the components, systems and facilities meet design requirements and (2) to train user personnel in the arrangement, location, control, and operation of the completed facility.

18.2 Knowledge Transfer

The project organization works closely with a user in developing and presenting (or helping present) specific support to the user operations and maintenance forces. The "driver" for this activity is to transfer project knowledge and experience to the user prior to closeout of the project and reassignment of project personnel. Training should include both classroom and hands-on (performance-based). If possible, project personnel should remain available "as needed" through facility cold operation.

18.3 DOCUMENTATION

Turnover of a completed project shall include the turnover of appropriate project documentation/records to the user. Records in this activity must include design, procurement, construction, preoperational, startup, safety, and as-builts. Records should be complete, properly identified, approved, and orderly. Records not provided to the customer are prepared for storage. In certain cases, electronic and hard copies of project records are provided. Documentation is further discussed in Practice 16, Records.

18.4 LESSONS LEARNED

At completion, the project shall prepare and distribute a lessons learned document. If properly planned, a project lessons-learned program is in-place when the project is organized, with frequent distribution of interim lessons learned reports. The final lessons learned report then becomes the assembling and issuing of prior reports as a single document.

18.5 OTHER

There are other activities leading to orderly cost-effective project turnover. **A project manager shall perform <u>or</u> assure these activities are performed prior to turnover, project closeout, and personnel reassignment.**

At the time of project turnover and project closeout, and before any personnel are reassigned, the following list is typical of items to be provided, and documents to be made complete and available:

- Operating and maintenance manuals and procedures
- Vendor data files, including drawings, manuals, and specifications
- Preventive maintenance procedures as well as preventive maintenance records for those items of equipment purchased by the project that have or will require preventive maintenance prior to turnover
- Special tools, lubricants, and spare parts as recommended by vendors, with sufficient inventory provided for one year of operation

- Complete red-line or as-built drawings that have been verified by system walk-downs. Also, as-built specifications for those equipment items that have an operating lifetime less than the facility design lifetime.
- Sufficient cold chemicals for any planned cold runs requirements prior to facility hot operation.

18.6 OPERATIONAL READINESS REVIEWS (ORR)/READINESS ASSESSMENT (RA)

The project shall consider, plan, and work towards ORR/RA activities throughout the project lifetime. In addition, the project shall initiate all actions and activities that will improve or accelerate the ORR/RA process.

Specific guidance and direction can be found in

- DOE 0 425.1A, Startup and Restart of Nuclear Facilities
- DOE-STD-3006-95, Planning and Conduct of Operational Readiness Reviews (ORR)
- DOE-HDBK-3012-94, Team Leader's Preparation Guide for Operational Readiness Reviews (ORR).

The project team should cooperate and serve as a support system during the planning, performance, and completion/closeout of the ORR/RA.

19 CLOSEOUT

Termination of a project involves bringing a project to a planned and orderly conclusion. Project termination is planned with care and attention as are other project phases. Termination and closeout is to avoid an occurrence where project personnel either leave or are reassigned prior to final project closeout, leaving others to “clean up.”

The two primary issues that arise during completion are procedural issues and emotional issues. The Project manager must effectively resolve both.

19.1 DEMOBILIZATION

Demobilization is a significant event for the project manager and the project personnel. Emotional issues involve (1) project team breakup and loss of identity, (2) a need for fewer personnel during project completion, (3) pressure from functional organizations to return personnel, and (4) concern of project workers about their next assignment. To smooth the demobilization process, the project manager considers the following actions:

- ► Prepare and issue a closeout plan, including an evaluation of existing resource requirements.
- ► Meeting with the project team to finalize remaining tasks and provide support to remaining team members.
- ► Determine assignments for final documentation, such as a summary status report, budget report, final costs report, and executive summary.
- ► Work with functional peers and team members to establish clear phase-out procedures in terms of each individual’s responsibilities.
- ► Meeting with human resources, functional managers, and line managers to identify personnel needs; assist team members in scheduling interviews and participate in matching needs, capabilities and availability.
- ► Hold a final meeting or social function during which the project manager acknowledges and recognizes the contributions of all project participants.

19.2 CLOSEOUT

Closeout involves: (1) procedural issues and phase-out administrative procedures, (2) transfer of responsibilities, (3) cost closure activities, and (4) preparation of appropriate documentation. **To ensure orderly closeout of a project, the project shall, at the direction of DOE, and once all costs are incurred against the project with invoices and contracts closed, prepare a project closeout report following the approval of Critical Decision 4, Approve Start of Operations or Project Closeout.** The purpose of a project closeout effort is to assure a timely, orderly, cost-effective project termination. Using a graded approach, the following items should be addressed in the closeout report:

- Technical, cost, and schedule baseline accomplishments
- Final Cost Report with details as required (including claims settlement strategy where appropriate)
- Deactivation and decontamination planning (if required)
- Closeout approvals
- Permits, licenses, and/or environmental documentation
- Contract closeout status
- Lessons learned
- Adjustments to obligations and costs
- Photographic documentation
- Baseline change control log
- Turnover and formal acceptance of official project files.